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AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING:

ADVANCED SQUADRON VT86-RIO

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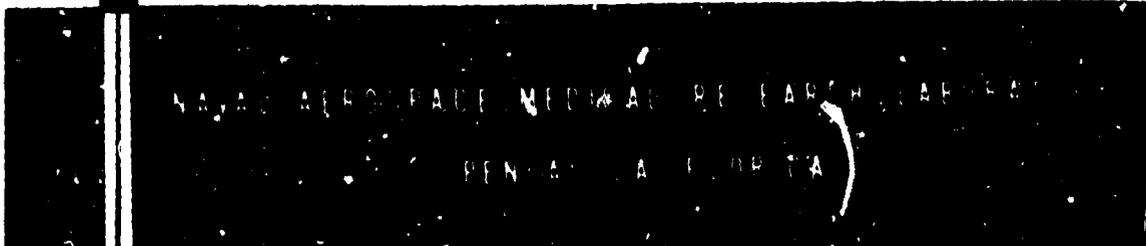
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SUMMARY PAGE

THE PROBLEM

Airsickness in Naval Flight Officer (nonpilot) training squadrons
can be considered to be a significant biomedical risk having both direct
and indirect influence on the cost of training aircrew personnel. During
flight, airsickness can degrade student performance and sometimes neces-
sitate repeat hops to achieve training objectives. Additional dollar
costs also result when students attrite because of airsickness, with
these costs rising rapidly when the attritions occur late in the training
program or even later in fleet assignments. Currently, there are few
operational data available to describe either the actual incidence or
resulting costs of the airsickness risk in these squadrons, and hence,
there is insufficient information available for flight surgeons and
medical boards to make decisions concerning disposition of airsick
individuals. In addition, validated biomedical tests of motion sickness
susceptibility to screen and select aircrew candidates best suited for
fleet assignments involving different degrees of motion stress are not
yet available.

FINDINGS

A longitudinal study has been initiated of airsickness problems in
the primary, secondary, and type-specific fleet readiness (RAG) squadrons
comprising the complete Naval Flight Officer (NFO) Training Program.
Flight performance data, based upon both instructor and student judgments
of airsickness severity, are being collected in these squadrons on an
individual-student basis. In addition, a large segment of the study
population has been exposed to several prototype laboratory tests of
motion sensitivity which will be related to the subsequent flight data.
In addition to identifying the incidence and severity of airsickness in
the individual squadrons, these flight data will have the potential to
serve as operations-based validation criteria for establishing the
relative merit of the different components of the laboratory test battery.

This report describes the airsickness experiences of 79 NFO students
being trained in Squadron VT86-RIO (Secondary level of training) to perform
various radar intercept and weapon operation duties. Flight data, based upon
2,048 hops flown by these students, are presented which show that approximately
83 percent of the total population reported being airsick on one or more
hops, 47 percent reported vomiting on one or more hops, and 48 percent
considered their inflight performance to have been degraded by airsick-
ness on one or more hops. Of the total number of hops flown by the
students, airsickness, vomiting, and inflight performance degradation
occurred on approximately 15. , 6.2, and 4.4 percent, respectively, of
the total flights. Comparative analyses of the flight data collected
in this squadron with similar data collected from the same population
during basic training in Squadron VT10 indicate that the incidence of air-
sickness was approximately the same for both levels of training. As with
the other reports of the series, data are also presented which relate the
flight performance of this specific subpopulation of the longitudinal study
to their performance on the laboratory tests of motion reactivity.

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ACKNOWLEDGMENTS

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INTRODUCTION

This is the third of a series of research reports dealing with a
longitudinal study of airsickness in Naval Flight Officer (NFO) students
being trained for a variety of nonaviator flight assignments in fleet
squadrons. The study, described in detail in the first report (3) of
the series, was designed to investigate the incidence and severity of
airsickness experienced by a sample of the NFO population on an individual-
student basis as they progress through the basic (primary level), advanced
(secondary level), and fleet readiness (commonly referred to as RAG)
squadrons comprising the NFC training syllabus. The study also relates
the airsickness data collected in the flight environment to the performance
of the students on several motion reactivity tests which were presented
to a large segment of the study population prior to their beginning
flight training. The long-term objective here is to utilize the inflight
airsickness data as validation criteria to measure the relative effectiveness
of the motion reactivity tests in identifying, on an a priori basis,
both those students who are highly susceptible to airsickness and those
students who rarely experience the problem. The inflight airsickness
data thus serve this test validation function as well as defining the
magnitude of the airsickness problem within each training squadron.

This report deals with the airsickness reported by NFO students
during training in Advanced Squadron VT86-RIO. These students constituted
one of four student groups whose airsickness in basic training (Squadron
VT10) was previouly reported (3). The layout and format of the statistical
tables and figures presented in this report have been selected to closely
duplicate the tables and figures of the first report to facilitate
reader comparison of the results associated with each squadron.

PROCEDURE

Figure 1 is a block diagram of the different training pipelines
followed by NFO students before assignment to the operational flight
squadrons. This report deals with the airsickness problem in Advanced
Squadron VT86-RIO where NFO students are trained in T39-D and TA-4J
aircraft for a variety of nonpilot duties in fighter aircraft, such as
the F4 and F14. At the time the study was initiated, the Squadron VT86-
RIO flight syllabus was composed of 27 individual hops, the abbreviated
names of which are shown inside the related block within Figure 1. All
of the data presented in this report pertain to this specific syllabus,
the details of which are outlined in Appendix A. (Midway in the study,
the Squadron VT86-RIO flight syllabus was changed and reduced to a total
of 24 hops. Airsickness data from the new syllabus will be presented
in a subsequent report.)

To document the incidence and severity of airsickness experienced
by a student during training, the two-sided questionnaire developed for
the initial study (3) was again used. One questionnaire was completed
for each hop flown, with separate sections provided for student and
instructor evaluations of the student's airsickness reactions. In
Figure 2, the student element of the questionnaire is shown at the top,
and the instructor element at the bottom. To minimize problems with

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NAVAL FLIGHT OFFICER TRAINING PIPELINES

Diagram contents:

- SQUADRON VT10* NFO BASIC TRAINING
- *PRE-1978 SYLLABUS
- N = 79
- ADVANCED TRAINING MAFB
- ADVANCED TRAINING VT86-AJN
- ADVANCED TRAINING * VT86-RIO — TWENTY-SEVEN HOPS, RT1 - RT22, AN1 - AN2, D1 - D3
- ADVANCED TRAINING ATDS
- ATTRITES N = 9
- N = 70
- AIRCRAFT P3
- AIRCRAFT S3 A6 EA6
- AIRCRAFT F14 F4
- AIRCRAFT E2
- FLEET READINESS SQUADRONS (RAG)
- FLEET SQUADRONS

Figure 1

Block diagram showing training pipelines followed by Naval Flight Officer students beginning with basic training and progressing through various advanced and fleet readiness (RAG) squadrons before receiving fleet assignments. This report deals with airsickness incidence in Advanced Training Squadron VT86-RIO.

STUDENT FORM　　　**NAMI / NAMRL AIRSICKNESS RESEARCH PROJECT**　　　**STUDENT FORM**

CC 01-09 Student SSN	10-13 Squadron No.	14-17 Hop No.	19-21 Julian Date	23-25 T/O Time (local)

PLEASE ESTIMATE THE FOLLOWING BY MARKING THE APPROPRIATE ANSWER: REPLY TO EACH QUESTION

AIRSICKNESS (Feeling motion sick whether you vomited or not)	NONE	MILD	MODERATE	SEVERE	26
VOMITING	NONE	ONCE	TWICE	THREE OR MORE TIMES	27
PERFORMANCE DEGRADATION (Due to airsickness)	NONE OR N/A	MILD	MODERATE	SEVERE	28
NERVOUSNESS (Experienced before/during this flight)	NONE	MILD	MODERATE	SEVERE	29
Did you take any medication for airsickness for this flight?	NO	YES			30

T-39 FLIGHTS SHOULD ALSO COMPLETE THE FOLLOWING

List hops in order flown for this flight	31-34	35-38	39-42	43-46	
Check the box under YOUR hop.					47
If airsick, when did it occur relative to YOUR hop? (Mark more than one box if appropriate)	NOT AIRSICK 48	BEFORE 49	DURING 50	AFTER 51	

FOLD ALONG THIS LINE

INSTRUCTOR FORM　　　**NAMI / NAMRL AIRSICKNESS RESEARCH PROJECT**　　　**INSTRUCTOR FORM**

NAME OF STUDENT (last name first, initials)	

PLEASE ESTIMATE THE FOLLOWING BY MARKING THE APPROPRIATE ANSWER: REPLY TO EACH QUESTION

AIRSICKNESS *** (Student appeared motion sick whether he vomited or not)	NONE	MILD	MODERATE	SEVERE	53
VOMITING	NONE	ONCE	TWICE	THREE OR MORE TIMES	54
PERFORMANCE DEGRADATION (Due to Airsickness)	NONE OR N/A	MILD	MODERATE	SEVERE	55
APPARENT NERVOUSNESS (Before and/or during the flight)	NONE	MILD	MODERATE	SEVERE	56
ROUGHNESS OF FLIGHT (Turbulence or pilot technique)	NONE	MILD	MODERATE	SEVERE	57
If this hop incomplete, was airsickness a factor? (Mark more than one box if appropriate)	NONE OR N/A 58	YES This Student Airsick 59	YES Another Student Airsick 60	YES Instructor Airsick 61	
Please record flight grades Example [0][3] for 3	U 62-63	BA 64-65	A 66-67	AA 68-69	

INSTRUCTOR COMMENTS	70

*** NOTE TO INSTRUCTOR: Research has shown that some people can feel very sick without vomiting. As a reminder, some of the signs of airsickness are pallor, sweating, heavy breathing, facial expressions, excessive swallowing, drowsiness, and verbal complaints. However, USE YOUR OWN JUDGEMENT.

Figure 2

Student (top) and instructor (bottom) airsickness questionnaire utilized to collect the flight data. For the actual questionnaire, the student form was printed on one side of the sheet and the instructor form on the opposite side with a self-adhesive tab provided to allow the student to seal the folded questionnaire before the instructor entered his ratings.

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confidentiality of questionnaire data, the student and instructor sections were printed on opposite sides of the form. By use of a fold line and adhesive tab, the student sealed his responses from view before the instructor completed his side of the form.

The details of the questionnaire have been described in the first report (3) of the series. For the student questionnaire, the key elements were four forced-choice ratings of airsickness experienced during the flight, number of times vomiting occurred, flight performance degradation as a result of airsickness, and any nervousness experienced before or during the flight. A fifth item requested a yes or no answer concerning the use of airsickness medication on the hop. The instructor also provided ratings of the same four airsickness, vomiting, performance degradation, and nervousness parameters rated by the student. In addition, the instructors were asked to rate the roughness of flight, i.e., atmospheric turbulence or pilot technique, encountered on the hop.

The motion reactivity test data presented for the VT86-RIO student population in this report were collected prior to the time the students began their NFO flight training in Basic Squadron VT10. Brief descriptions of these tests are provided in Appendix B, with related references that provide more detailed information on test techniques and procedures. The general methods used in the computer storage of these motion reactivity test data and the related flight airsickness data are outlined in the first report (3) of the series.

RESULTS AND DISCUSSION

A total of 2,048 validated airsickness questionnaires involving 79 VT86-RIO students were collected during this phase of the longitudinal study. As indicated in Figure 1, of the total of 79 students for which flight data were available, 70 (88.6 percent) were graduated from Squadron VT86-RIO and assigned to various fleet readiness squadrons for further training; nine (11.4 percent) attrited from the squadron before completing training. For the purposes of this study, the attrition total is limited to only those students who attrited after beginning inflight training as marked by the return of one or more completed airsickness questionnaires. Of the total number of attrites, three students dropped out of the program at their own request (DOR), two were not physically qualified (NPQ), one was both not aeronautically adaptable (NAA) and NPQ, and the remaining three were dismissed from the training program as a result of practical work failure (PWF) involving either inadequate academic or flight performance.

The study results are reported and discussed under seven different subheadings in conformance with the format used in the related Squadron VT86-AJN report (4). In the first section the data derived from the student and instructor questionnaires are used to define the incidence and severity of airsickness on each of the hops comprising the Squadron VT86-RIO syllabus. In the second section the questionnaire data are discussed in relation to the contribution of students experiencing repeated airsickness to the over-all airsickness incidence figures. In the third section unweighted and weighted airsickness indices are developed

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on an individual-student basis to quantitatively define the airsickness experiences of the squadron population as a whole. This section also includes statistics describing the performance of the students on the laboratory motion reactivity tests which were administered to a large segment of the group before they began NFO training. The fourth section provides a brief comparison of the airsickness indices and laboratory test scores of the students who were graduated from the squadron with the students who attrited from the squadron prior to graduation. The fifth section utilizes the flight indices to both define and compare the performance of nonsusceptible student groups with the most susceptible student groups within the over-all population. The sixth section presents a rank correlation matrix analysis of the relationships found to exist between and across the different flight indices and laboratory test scores. The last section compares the VT86-RIO squadron flight indices of airsickness with the VT10 basic squadron indices of the same students.

AIRSICKNESS INCIDENCE AND SEVERITY: INDIVIDUAL-HOP BASIS

The airsickness and related response measures derived from the questionnaires are tabulated in Table I for each of the 27 hops comprising the VT86-RIO syllabus. The table contains separate listings for the student and instructor ratings of the incidence and relative magnitude of the four principal response measures of the study; i.e., airsickness, vomiting, inflight performance degradation caused by airsickness, and nervousness. For each of these measures, four percentage values corresponding to classifications present, mild, moderate, severe are presented for each of the 27 hops. Each datum below a given hop name (see Appendix A for a brief description of each hop) represents the percentage of the total number of hops flown of the given type where the denoted response occurred. The first datum presented for a given response, e.g., "Airsickness-Present," is the percentage of the hops where airsickness was present without qualification as to the magnitude (mild, moderate, or severe) of the response. The three following values describe the percent incidence of mild, moderate, and severe ratings, respectively, for the denoted questionnaire item. In the case of the vomit measure, the breakdown is based upon the number of times the response occurred on a given flight. The student questionnaire tabulation also contains a line item describing the percent incidence of flights where the students reported that airsickness medication was used. In the instructor tabulation, separate listings are provided for flight turbulence and a breakdown of the grades issued on a given hop. The data presented in the "Total" column at the extreme right in the table represent the percentage of the total number of hops flown (2,048) where the denoted responses were present.

As indicated in the "Total" column of Table I, the students reported that airsickness (mild, moderate, or severe) was present on 15.7 percent of the hops flown during advanced training in this squadron; their instructors estimated the incidence to be only 7.1 percent. These figures indicate that airsickness incidence in this advanced training squadron was of the same general magnitude as that observed during basic training in Squadron VT10 where the students and instructors reported (3) airsickness on 16.2 and 10.2 percent, respectively, of the total hops flown. In the case of the vomit measure, the VT86-RIO students

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Table 1

Percent incidence of airsickness and related flight questionnaire responses on the 32 hops comprising the pre-1978 flight syllabus of Advanced Training Squadron VT9b-R10. Student and instructor questionnaire data are listed separately with each datum shown below a given hop representing the percentage of the total hops flown of the given type where the denoted response occurred. The total column at the right represents the percent incidence of a given response based upon all the hops flown by the 34 NFO students comprising this specific study population.

INDIVIDUAL HOPS COMPRISING SQUADRON FLIGHT SYLLABUS

FLIGHT QUESTIONNAIRE RESPONSES
HOPS FLOWN-PERCENT OF TOTAL
S-AIRSICKNESS-PRESENT
S-AIRSICKNESS-MILD
S-AIRSICKNESS-MODERATE
S-AIRSICKNESS-SEVERE
S-VOMITING-PRESENT
S-VOMITING-1 TIME
S-VOMITING-2 TIMES
S-VOMITING-3 OR MORE TIMES
S-PERF DEGRADATION-PRESENT
S-PERF DEGRADATION-MILD
S-PERF DEGRADATION-MODERATE
S-PERF DEGRADATION-SEVERE
S-NERVOUSNESS-PRESENT
S-NERVOUSNESS-MILD
S-NERVOUSNESS-MODERATE
S-NERVOUSNESS-SEVERE
S-MEDICATION USED ON HOP
I-AIRSICKNESS-PRESENT
I-AIRSICKNESS-MILD
I-AIRSICKNESS-MODERATE
I-AIRSICKNESS-SEVERE
I-VOMITING-PRESENT
I-VOMITING-1 TIME
I-VOMITING-2 TIMES
I-VOMITING-3 OR MORE TIMES
I-PERF DEGRADATION-PRESENT
I-PERF DEGRADATION-MILD
I-PERF DEGRADATION-MODERATE
I-PERF DEGRADATION-SEVERE
I-NERVOUSNESS-PRESENT
I-NERVOUSNESS-MILD
I-NERVOUSNESS-MODERATE
I-NERVOUSNESS-SEVERE
I-TURBULENCE-PRESENT
I-TURBULENCE-MILD
I-TURBULENCE-MODERATE
I-TURBULENCE-SEVERE
I-FLT GRADES-ISSUED ON HOP
I-FLT GRADES-UNSATISFACTORY
I-FLT GRADES-BELOW AVERAGE
I-FLT GRADES-AVERAGE
I-FLT GRADES-ABOVE AVERAGE

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

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and instructors reported that this response occurred on 6.2 and 4.5
percent, respectively, of the total hops flown. Corresponding figures
for inflight performance degradation due to airsickness were 4.4 and 2.1
percent, respectively, of the total flights. Student nervousness, experi-
enced either prior to or during a flight, was reported by the students and
instructors on 21.7 and 14.8 percent, respectively, of the flights. In
general, the magnitude of the airsickness problem in this advanced squad-
ron was considerably higher than that reported (4) for its VT86-AJN
counterpart.

To illustrate the relative magnitude of the airsickness problem
among the different hops comprising the Squadron VT86-RIO flight syllabus,
selected elements of Table I have been plotted in Figures 3 through 9.
In these figures, each hop is identified with an abbreviated code that
is explained in Appendix A. All of the hops were flown in the multi-
seated T39-D aircraft with the exceptions of D1-D3 which were flown in
the two-seated TA-4J aircraft. The hop name-labeling sequence in these
figures reading from left to right follows, in general, the sequence
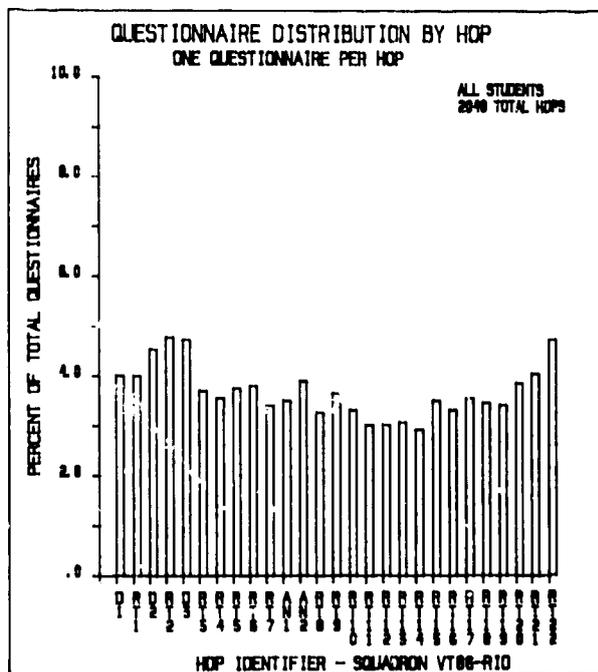
Figure 3

Plot of relative distribution of airsickness questionnaires received during the study as a
function of the individual hops comprising the squadron flight syllabus. Each bar above a
given hop corresponds to the percentage of the total number of questionnaires collected during
the study that pertained to the specific hop. The left-to-right hop sequence shown corres-
ponds in general to the sequence that the students flew the hops, although there were excep-
tions within each hop series.

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that the students flew the hops, although there were variations from
student to student. This sequence was determined by numbering each hop
flown by a given student in the order that it was flown and calculating
the mean ordinal number for the named hop for the entire student group.
Since questionnaires were not necessarily received from every student
for every flight comprising the syllabus, this mean sequence only approx-
mates the actual order of the different hops. From a practical viewpoint,
this method well approximates the over-all hop sequence flown by the
majority of the students, with the chance of sequence error greatest
between any two adjacent hop listings for a given student.

The distribution of the basic flight data available for analysis
for each hop is depicted in Figure 3 where the number of questionnaires
collected for a given hop is expressed as the percentage of the total
number (2,048) of questionnaires received. Variations in the exact
number of questionnaires received per hop are due to less than 100 percent
return, which was sometimes compensated by repeat hops flown by the stu-
dents. Of the 2,048 questionnaires received, 273 (about 13 percent)
involved students repeating a hop they had previously flown.

In Figure 4 the student and instructor ratings of airsickness are
compared for each hop. Figure 4A plots the incidence of airsickness,
regardless of degree of severity, that occurred on a given hop as the
percentage of the total hops flown where airsickness was present.
Figures 4B, 4C, and 4D depict the percent incidence of hops where air-
sickness was present to a mild, moderate, and severe degree, respec-
tively. Figures 5, 6, and 7 represent equivalent plots of the incidence
of vomiting, inflight performance degradation due to airsickness, and
nervousness, respectively. A comparison of the relative level of the
student and instructor judgments in these four figures indicates the general
trend for the instructors to underestimate the students' estimates of their
own reactions, which agrees with previous reports (3,4). For this squadron,
Hops RT15 and RT20 produced the greatest motion stress, with the students
reporting the presence of airsickness on approximately 42 and 51 percent,
respectively, of the hops. Airsickness incidence during the first five
flights of the syllabus was also relatively high, ranging from 20 to 27
percent. Three of these hops (D1-D3) involved familiarization training
including acrobatics in the two-seated TA-4J jet trainer. As indicated by
Figure 7, the incidence of nervousness was also greatest on Hops RT15 and
RT20.

Figure 8 is a plot of the percent incidence of airsickness medi-
cation usage as reported by the students. These data indicate a decline
in the use of such medication following the first two hops of the syl-
labus and a rise toward the end of the flight program. As stated pre-
viously (3,4), this reported usage of medication during the late phases
of the flight syllabus requires further investigation since this practice
tends to allow airsick susceptibles to continue in the program without
the natural screening or attrition that might occur without medication.
The possibility that students are taking antimotion sickness medication
in anticipation of provocative hops is clouded by the fact that no student
reported taking medication for Hop RT15.
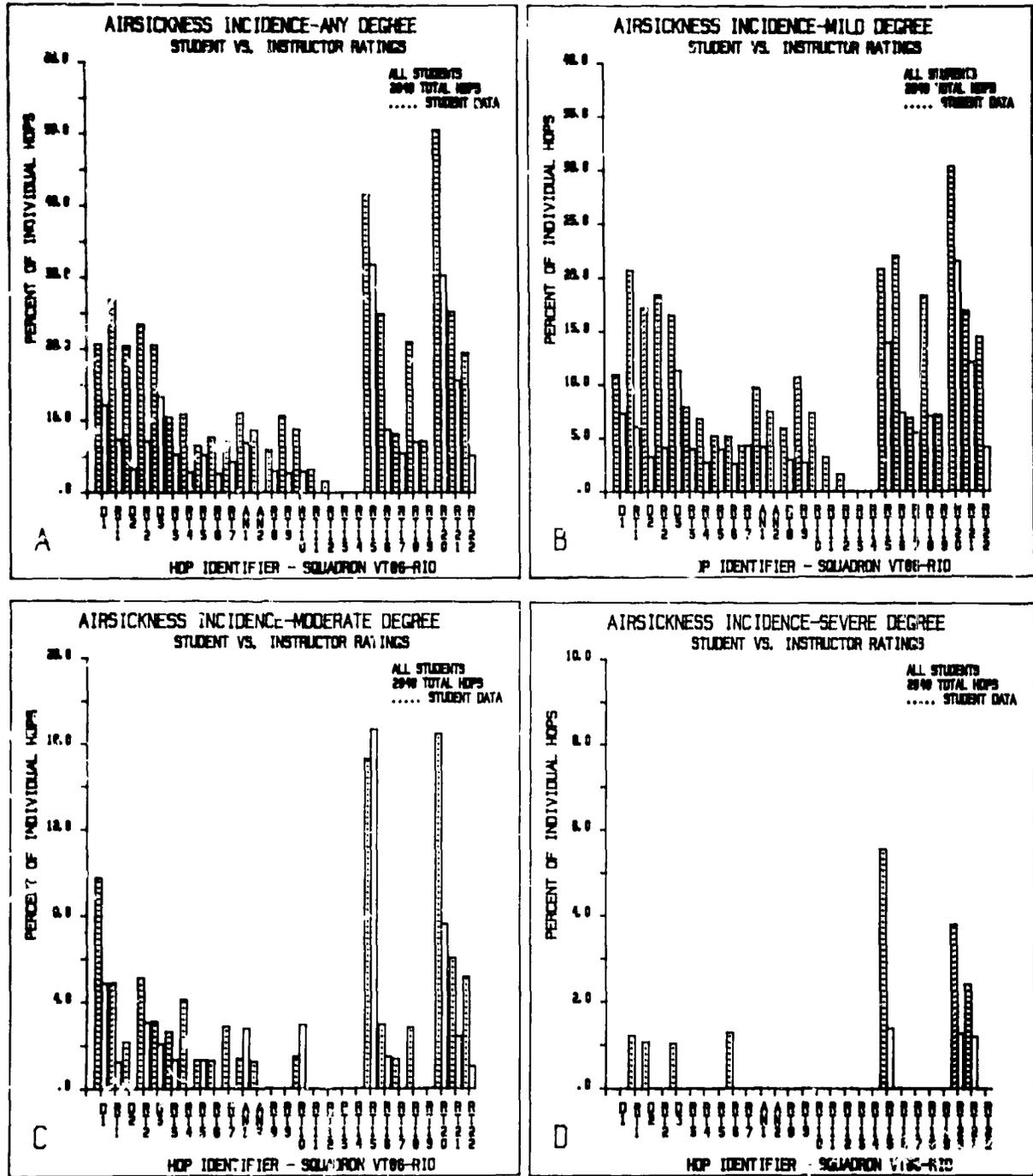
Figure 4

Comparison of student and instructor ratings of airsickness incidence and severity as a function of the individual hops. The incidence of airsickness of any degree (mild, moderate, or severe) is shown in A; the incidence of mild, moderate, and severe degrees of airsickness in B, C, and D, respectively. In each case, incidence is expressed as the percentage of the total number of hops flown of a given classification where the denoted response occurred. In general, the instructor judgments of airsickness incidence and severity underestimate those provided by the students. Hops RT15 and RT20 produced the greatest airsickness stress.

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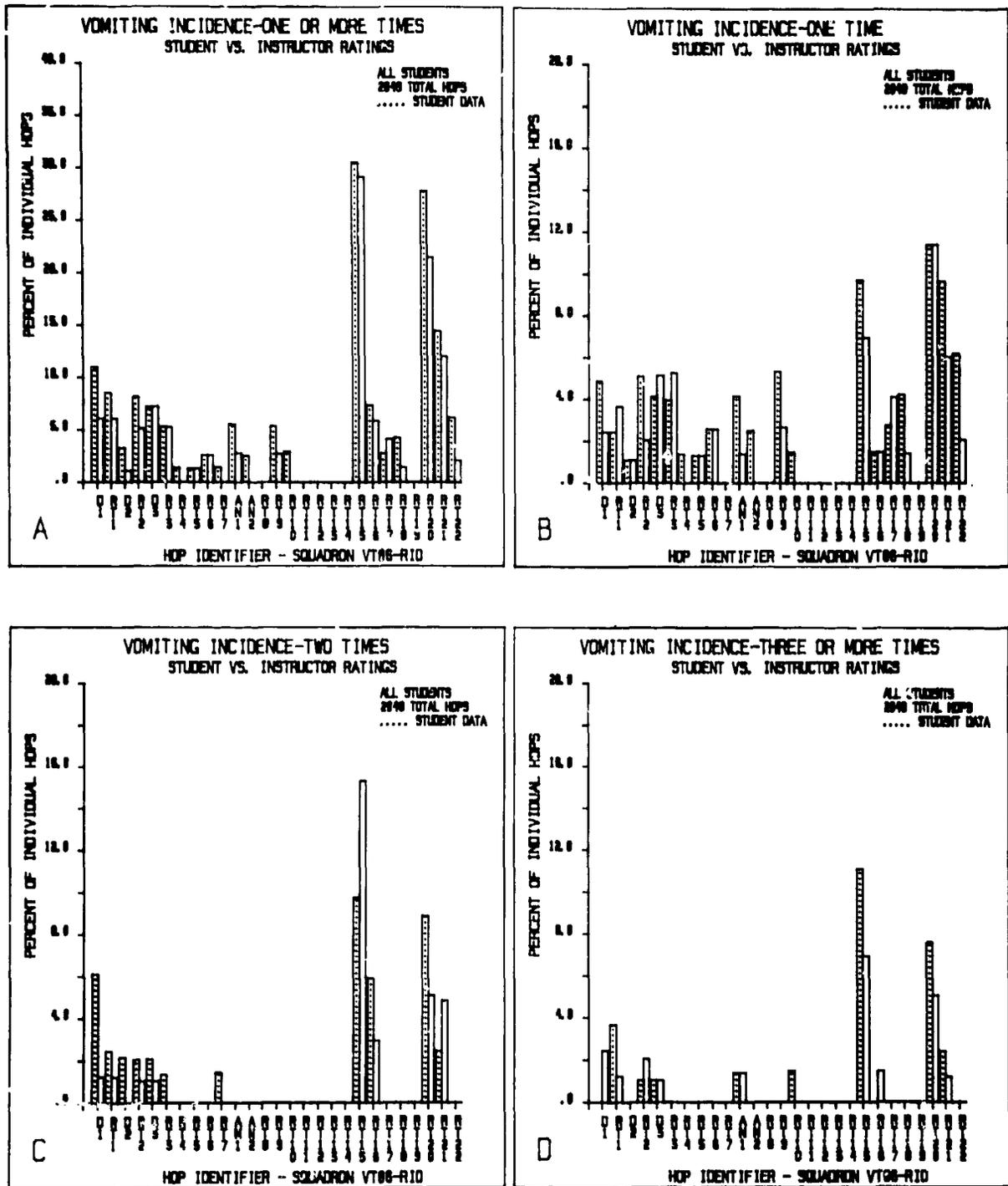
Figure 5

Comparison of student and instructor ratings of vomiting incidence as a function of the individual hops. The percent incidence of hops resulting in students vomiting one or more times is shown in A; the incidence of hops where the students vomited one, two, or three times is shown in B, C, and D, respectively.
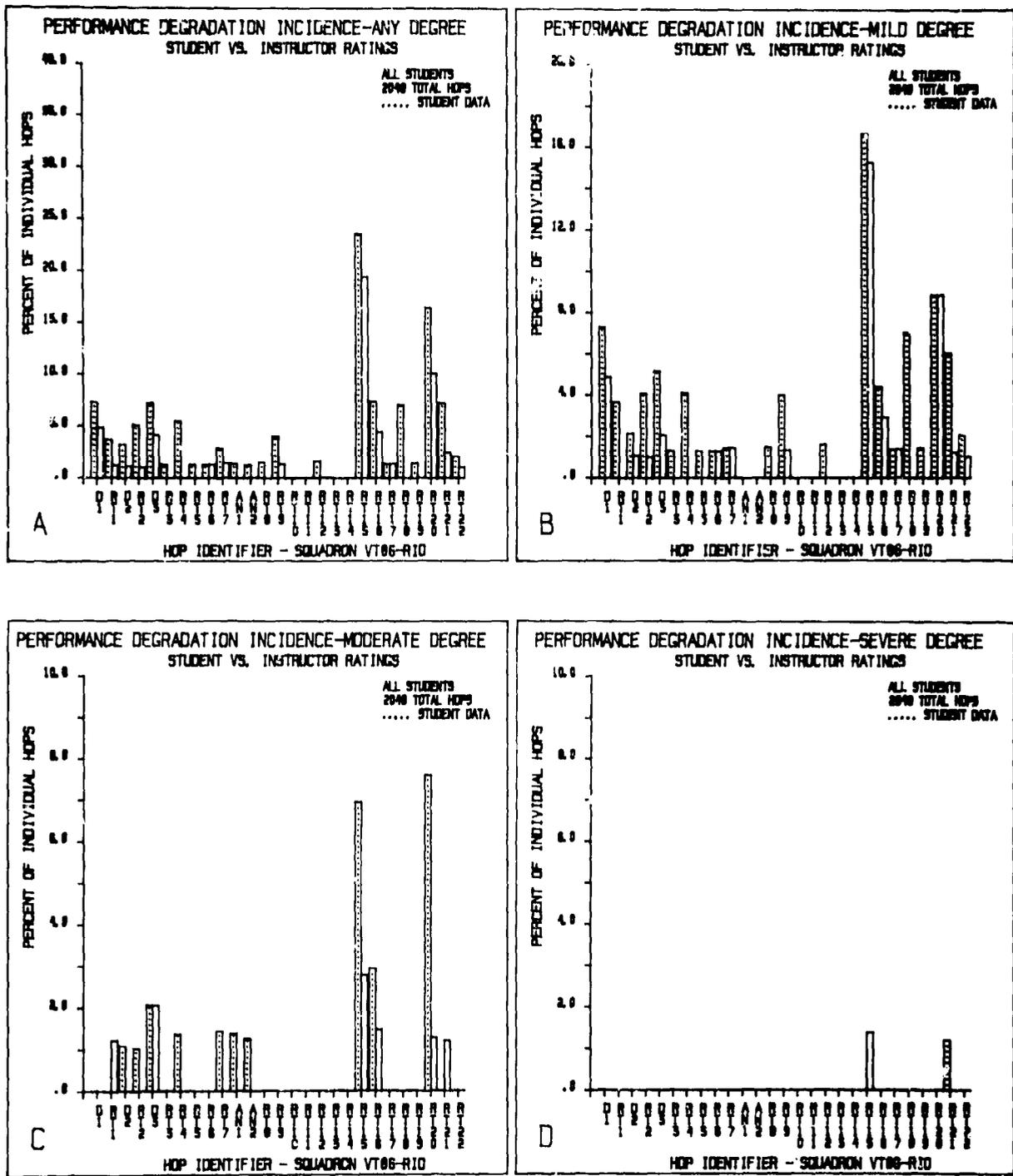
Figure 6

Comparison of student and instructor ratings of inflight performance degradation caused by airsickness as a function of the individual hops. On most hops, the students overestimated the extent of their performance degradation as compared to the instructor judgments.

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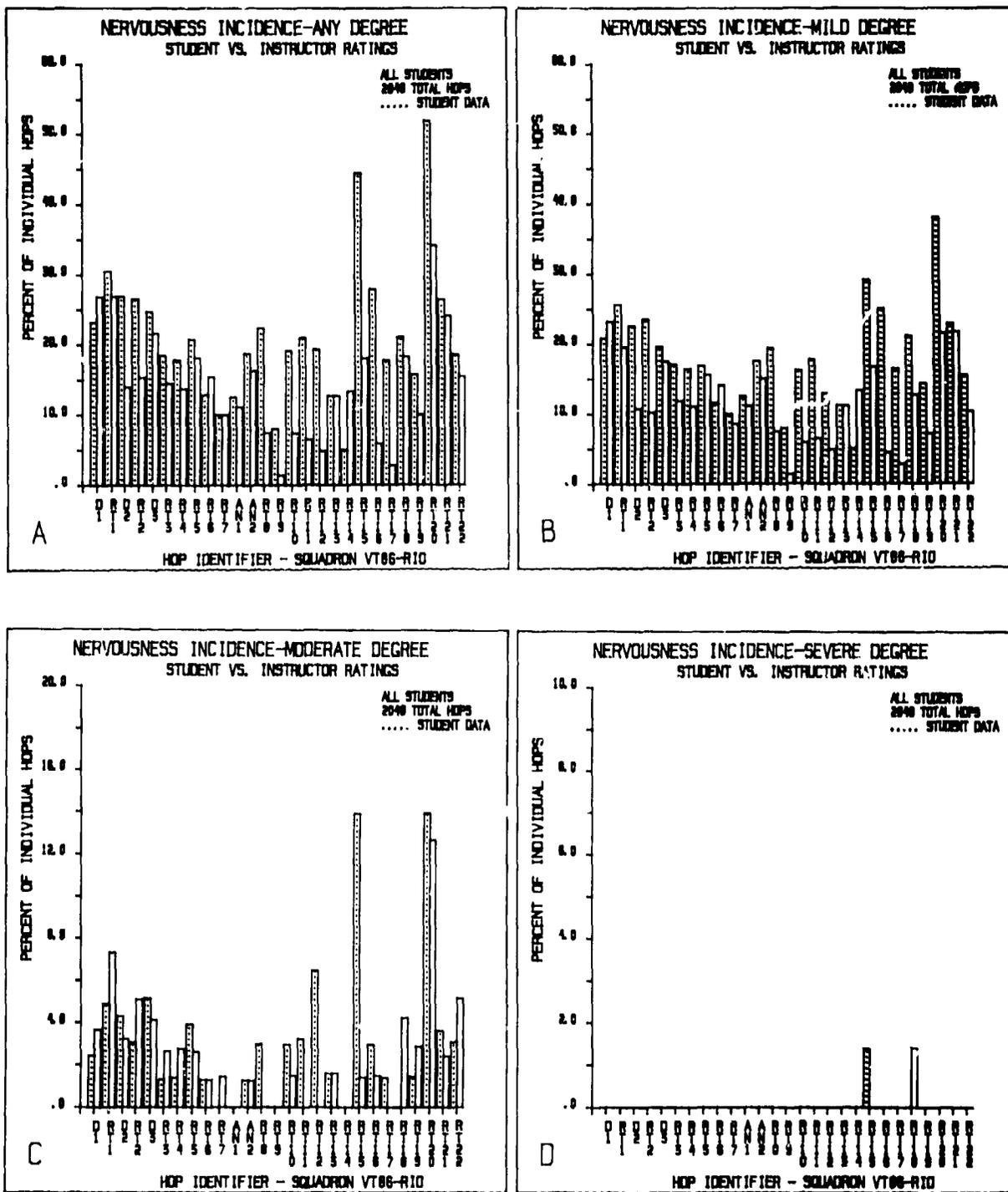
Figure 7

Comparison of student and instructor judgments of student nervousness before or during a given flight as a function of the individual hops.
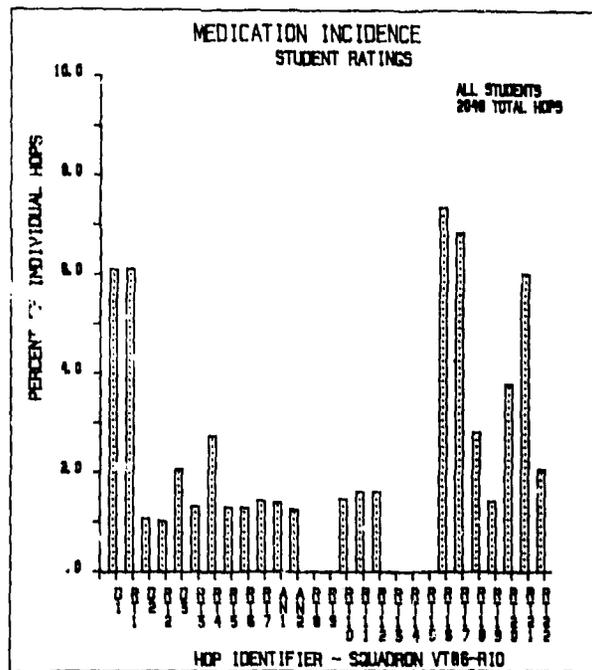
Figure 8

Percent incidence of flights where students reported using airsickness medication. The use of medication decreased following the first several hops but increased toward the end of the flight syllabus.

Some relationship between roughness of air and airsickness incidence was present but somewhat inconsistent. For example, comparing Figures 4A and 9A, airsickness did not occur on Hop RT13 which the instructors considered to be the least turbulent hop in the syllabus; and the maximum incidence of airsickness occurred on Hop RT20 which received the maximum turbulence incidence rating. However, on Hop AN1, airsickness incidence was relatively low, even though the turbulence rating for the hop was relatively high; the same observation applies to Hop RT19. As noted previously (3,4), this element of the questionnaire may have been complicated by the inclusion of the words, "pilot technique," in the roughness-of-air line item (Figure 2 - bottom), thus leading some instructors to rate a given hop in terms of the flight forces produced by the related maneuvers instead of simple atmospheric turbulence or buffeting.

The flight grade data listed in Table I are plotted as a function of the individual hops in Figure 10. The squadron grading protocol was such that an instructor issued one of four grades (average, above average, below average, or unsatisfactory) for each of the flight performance

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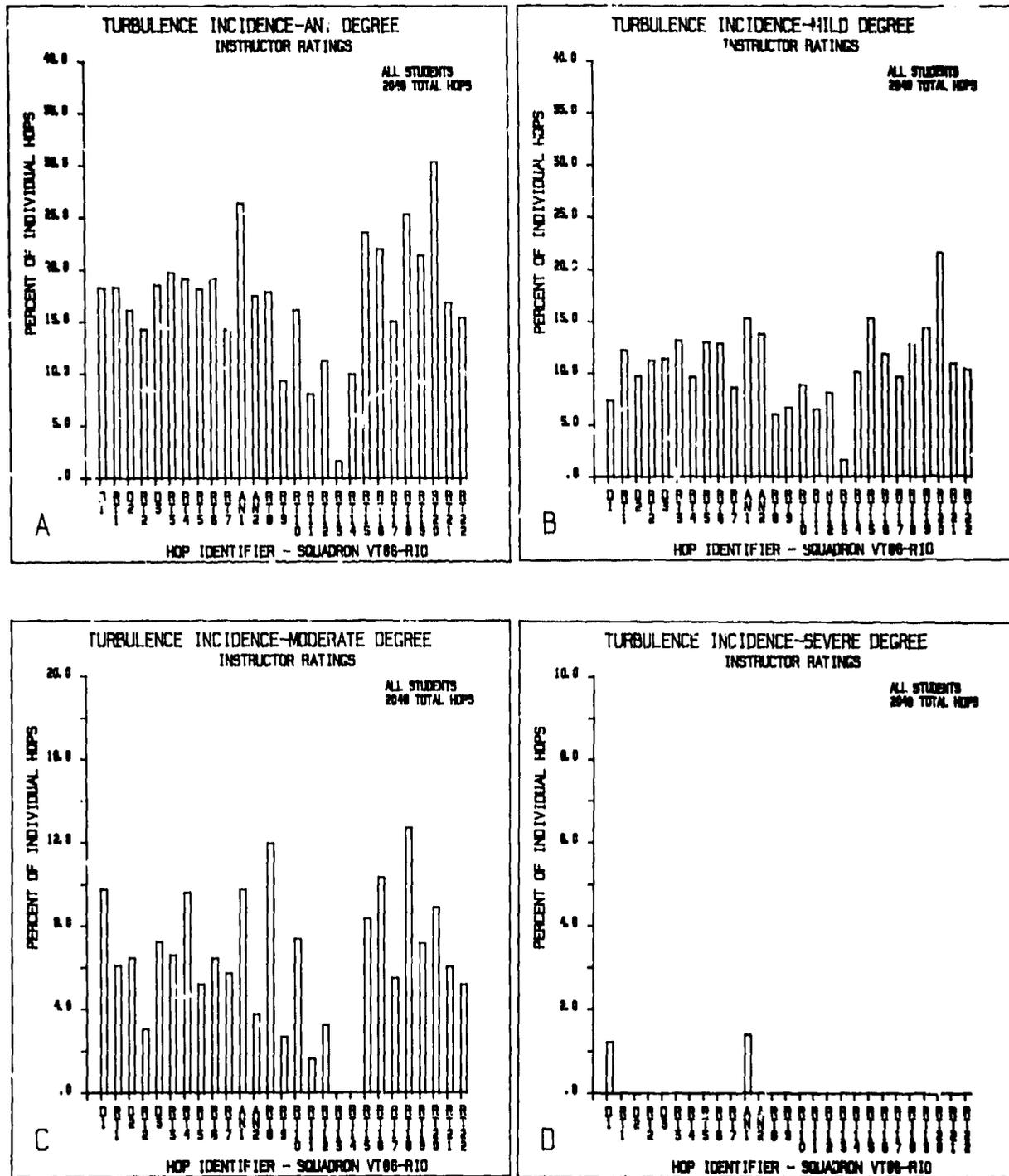
Figure 9

Percent incidence of turbulence (rough air or pilot technique) as a function of the individual hops.
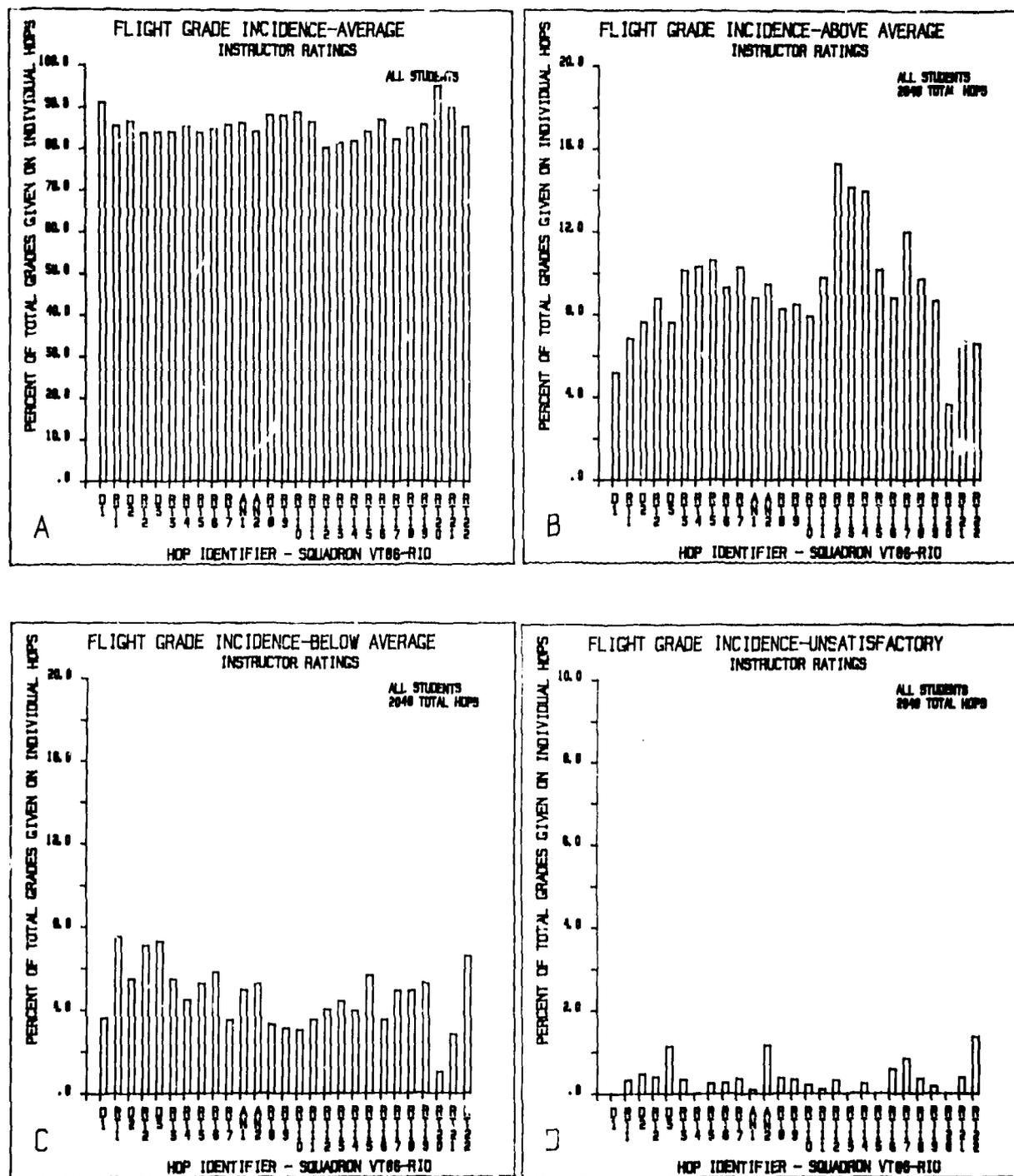
Figure 10

Percent incidence of average (A), above average (B), below average (C), and unsatisfactory (D) grades for the individual hops. The grading system is based upon assigning one of these four grades to each task performed on a given hop where the number of tasks graded varies from hop to hop. Each datum plotted in this figure represents the percentage of the total number of grades given on a specific hop where the denoted grade was issued.

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tasks to be practiced on a given hop. The percentage data plotted in Figure 10 are referenced to the total number of grades issued on a given hop. The "average" grade data of Figure 10 indicate a relatively even distribution across the individual hops. As with the related data collected previously for other squadrons (3,4), there is no obvious relationship between flight grades and airsickness. It is interesting to note that the flight grades on Hops RT15 and RT20 do not appear to reflect fairly high student and instructor ratings of performance degradation.

In the previous reports (3,4) dealing with airsickness incidence in Squadrons VT10 and VT86-AJN, it was found that certain hops flown near the end of the flight syllabus produced relatively high airsickness incidence. This finding was used to emphasize the point that adaptation effects cannot be deduced from a simple analysis of airsickness as a function of the number of hops flown within a given squadron. That is, airsickness incidence, at least for the NFO population, did not continuously decrease as the students progressed through the flight syllabus. When the hops involved relatively high motion stress levels, airsickness incidence rose even though the hops occurred toward the end of the flight program. The same trend may be observed for the Squadron VT86-RIO data. Again, these results suggest that conclusions concerning airsickness adaptation must be carefully weighed in relation to the motion stress level of each hop within a given flight syllabus.

AIRSICKNESS INCIDENCE AND SEVERITY: STUDENT FREQUENCY ANALYSIS

The flight data were also analyzed to establish the number of students who experienced a given response a repeated number of times during the course of their training. Table II is a tabulation of the results of this analysis for each of the principal questionnaire responses. Each datum in this table below a given column heading denotes the percentage of the total number of students who experienced a given response the number of times indicated by the column header. The total column at the extreme right in the table denotes the percentage of the total number of students who experienced the given response one or more times.

These total data indicate that 83.5 percent of the students reported being airsick on one or more flights during their VT86-RIO training, 46.8 percent reported vomiting on one or more flights, 48.1 percent reported inflight performance degradation due to airsickness on one or more flights, and 75.9 reported nervousness on one or more flights. The magnitudes of the three airsickness-related measures are considerably higher than those observed in Squadron VT86-AJN, reflecting the higher motion stress level of the Squadron VT86-RIO flight syllabus. As indicated by the 1.3 percent datum under the "18+" column heading of Table II, one persistent student reported being airsick on at least 18 of his hops. Table II, like Table I, reflects the lower magnitude of the instructor ratings as compared to those of the students. In this respect, several interesting interpretations arise from comparison of student and instructor reports of the presence of vomiting. In the most extreme cases in Table II, two students reported vomiting 14 times and two students reported vomiting 9 times. By comparison, the instructor group was aware of one student vomiting 13 times and one student vomiting 8 times. From these data, it

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Table II

Relative incidence of students experiencing repeated airsickness a different number of times during flight training in Squadron VT86-RIO. Each datum listed beneath a given column number represents the percentage of the total student population (N = 79) that experienced a given response the denoted number of times. The total column at the right represents the percentage of the total population that experienced a given response one or more times during flight training.

FLIGHT QUESTIONNAIRE RESPONSES	NUMBER OF TIMES RESPONSE EXPERIENCED																		TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+	
S-AIRSICKNESS-PRESENT	15.2	15.2	8.9	7.6	7.6	12.7	1.3	2.5	0	5.1	1.3	0	2.5	1.3	0	1.3	0	1.3	83.5
S-AIRSICKNESS-MILD	17.7	16.5	11.4	10.1	5.1	3.8	1.3	1.3	1.3	1.3	1.3	2.5	0	1.3	0	1.3	0	0	75.9
S-AIRSICKNESS-MODERATE	28.3	13.9	6.3	1.3	2.5	1.3	0	0	0	0	0	0	0	0	0	0	0	0	45.6
S-AIRSICKNESS-SEVERE	10.1	1.3	1.3	1.3	0	1.3	0	0	0	0	0	0	0	0	0	0	0	0	17.7
S-VOMITING-PRESENT	20.3	8.9	3.8	1.3	2.5	1.3	2.5	1.3	2.5	0	1.3	0	0	2.5	0	0	0	0	46.8
S-VOMITING-1 TIME	17.7	5.1	5.1	1.3	0	1.3	2.5	0	0	0	0	0	0	0	0	0	0	0	34.2
S-VOMITING-2 TIMES	8.9	6.3	3.8	1.3	1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	21.5
S-VOMITING-3 OR MORE TIMES	8.9	6.3	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.7
S-PERF. DEGRADATION-PRESENT	20.3	10.1	6.3	6.3	2.5	1.3	1.3	0	0	0	0	0	0	0	0	0	0	0	48.1
S-PERF. DEGRADATION-MILD	17.7	10.1	6.3	3.8	1.3	1.3	0	0	0	0	0	0	0	0	0	0	0	0	48.1
S-PERF. DEGRADATION-MODERATE	19.0	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22.8
S-PERF. DEGRADATION-SEVERE	1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3
S-NERVOUSNESS-PRESENT	8.9	13.9	10.1	3.8	7.6	5.1	1.3	1.3	1.3	1.3	0	2.5	5.1	2.5	1.3	2.5	1.3	6.3	75.9
S-NERVOUSNESS-MILD	8.9	15.2	7.6	5.1	8.9	3.8	2.5	1.3	3.8	1.3	0	1.3	7.6	0	0	0	2.5	3.8	73.4
S-NERVOUSNESS-MODERATE	19.0	2.5	3.8	0	2.5	2.5	0	1.3	1.3	0	0	0	0	0	0	0	0	0	32.9
S-NERVOUSNESS-SEVERE	1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3
S-MEDICATION USED ON HOP	3.8	2.5	2.5	0	2.5	1.3	0	0	0	1.3	0	0	0	1.3	0	0	0	1.3	13.9
I-AIRSICKNESS-PRESENT	27.8	16.5	5.1	2.5	7.6	2.5	3.8	0	0	0	1.3	0	0	0	0	0	0	0	67.1
I-AIRSICKNESS-MILD	27.8	12.7	7.6	3.8	3.8	1.3	0	0	0	0	0	0	0	0	0	0	0	0	58.2
I-AIRSICKNESS-MODERATE	15.2	12.7	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30.4
I-AIRSICKNESS-SEVERE	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.8
I-VOMITING-PRESENT	19.0	10.1	1.3	2.5	1.3	5.1	0	1.3	0	0	0	0	1.3	0	0	0	0	0	41.8
I-VOMITING-1 TIME	12.7	6.3	2.5	1.3	1.3	1.3	0	1.3	0	1.3	0	0	0	0	0	0	0	0	26.6
I-VOMITING-2 TIMES	13.9	5.1	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.5
I-VOMITING-3 OR MORE TIMES	11.4	1.3	1.3	0	1.3	0	0	0	0	1.3	1.3	0	0	0	0	0	0	0	15.2
I-PERF. DEGRADATION-PRESENT	17.7	2.5	1.3	2.5	0	0	0	5.1	1.3	0	2.5	0	0	0	0	0	0	0	29.1
I-PERF. DEGRADATION-MILD	16.5	2.5	3.8	2.5	0	0	0	3.8	0	0	0	0	0	0	0	0	0	0	25.3
I-PERF. DEGRADATION-MODERATE	10.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.1
I-PERF. DEGRADATION-SEVERE	1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3
I-NERVOUSNESS-PRESENT	16.5	15.2	21.5	16.5	1.3	8.9	1.3	5.1	2.5	1.3	1.3	2.5	0	1.3	0	0	0	0	94.9
I-NERVOUSNESS-MILD	17.7	20.3	17.7	11.4	7.6	6.3	1.3	3.8	1.3	0	2.5	0	0	0	0	0	0	0	89.9
I-NERVOUSNESS-MODERATE	29.1	6.3	5.1	0	1.3	1.3	0	0	0	0	0	0	0	0	0	0	0	0	43.0
I-NERVOUSNESS-SEVERE	1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3
I-TURBULENCE-PRESENT	5.1	22.8	15.2	8.9	12.7	5.1	12.7	3.8	5.1	0	1.3	2.5	1.3	0	0	0	0	0	96.2
I-TURBULENCE-MILD	17.7	21.5	17.7	11.4	5.1	6.3	6.3	2.5	1.3	0	0	0	0	0	0	0	0	0	87.3
I-TURBULENCE-MODERATE	24.1	22.8	16.5	6.3	2.5	1.3	0	0	0	0	0	0	0	0	0	0	0	0	73.4
I-TURBULENCE-SEVERE	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.5

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

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would appear that instructors are not always aware when a student vomits.
The question then arises - did the instructors miss these vomiting episodes,
or did the students attempt to conceal their airsickness? It should also
be noted that it is possible for a student with repetitive vomiting episodes
detected by his instructors to continue his flight training without drawing
unusual attention.

To emphasize the multiple contributions of a small number of students
to the over-all airsickness problem, the airsickness, vomiting, per-
formance degradation, and nervousness data have been plotted in cumu-
lative frequency distribution form in Figures 11A, B, C, and D, re-
spectively. The percentage of the total number of students who never
reported experiencing a given response is represented in these figures
by the intersection of the distribution curve with the ordinate axis.
That is, 16.5 percent of the students reported never being airsick, 53.2
percent reported never vomiting, 51.9 percent reported never suffering
from inflight performance degradation due to airsickness, and 24.1 percent
reported never experiencing nervousness prior to or during flight. From
these distribution data, it can be shown that 50 percent of the hops
where airsickness occurred was accounted for by approximately 19 percent
of the total number of students; 50 percent of the hops where vomiting
occurred was accounted for by approximately 8 percent of the students; 50
percent of the hops involving inflight performance degradation was accounted
for by approximately 12 percent of the students; and 50 percent of the hops
where nervousness occurred was accounted for by only 16 percent of the
students. As mentioned previously (3) the long-term objective in the
development of tests to predict airsickness susceptibility must center
on the identification of those individuals falling into the upper part,
e.g., the upper decile, of the Figure 11 distributions.

Normalized cumulative frequency distributions of the same form are
also plotted for student reports of medication usage in Figure 12A and
for instructor ratings of turbulence in Figure 12B. The significance of
the medication plot is that only eleven (13.9 percent) of the squadron
students reported using medication at some time during training. Of these
students, seven used medication on three or less flights, two on five flights,
one on six flights, and one on nineteen flights. As with the previously
reported squadron data (3,4), the incidence of medication usage shown in
Table I and plotted in Figure 8 was accounted for by a relatively small
number of students. The turbulence data of Figure 12B show that the
repeated exposure to roughness of air was more evenly distributed over
the population.

INDIVIDUAL STUDENT PERFORMANCE: AIRSICKNESS INDICES

Unweighted and weighted indices were calculated for the principal
components of the airsickness questionnaire data, using both the student
and instructor ratings. The indices allow comparisons to be made among
different squadrons and among different student subpopulations within
given squadrons. In addition, they are intended to serve the further
function of relating an individual's performance during basic training
with subsequent performance in advanced and fleet readiness (RAG) squad-
rons. As outlined in the first report (3), five unweighted and five
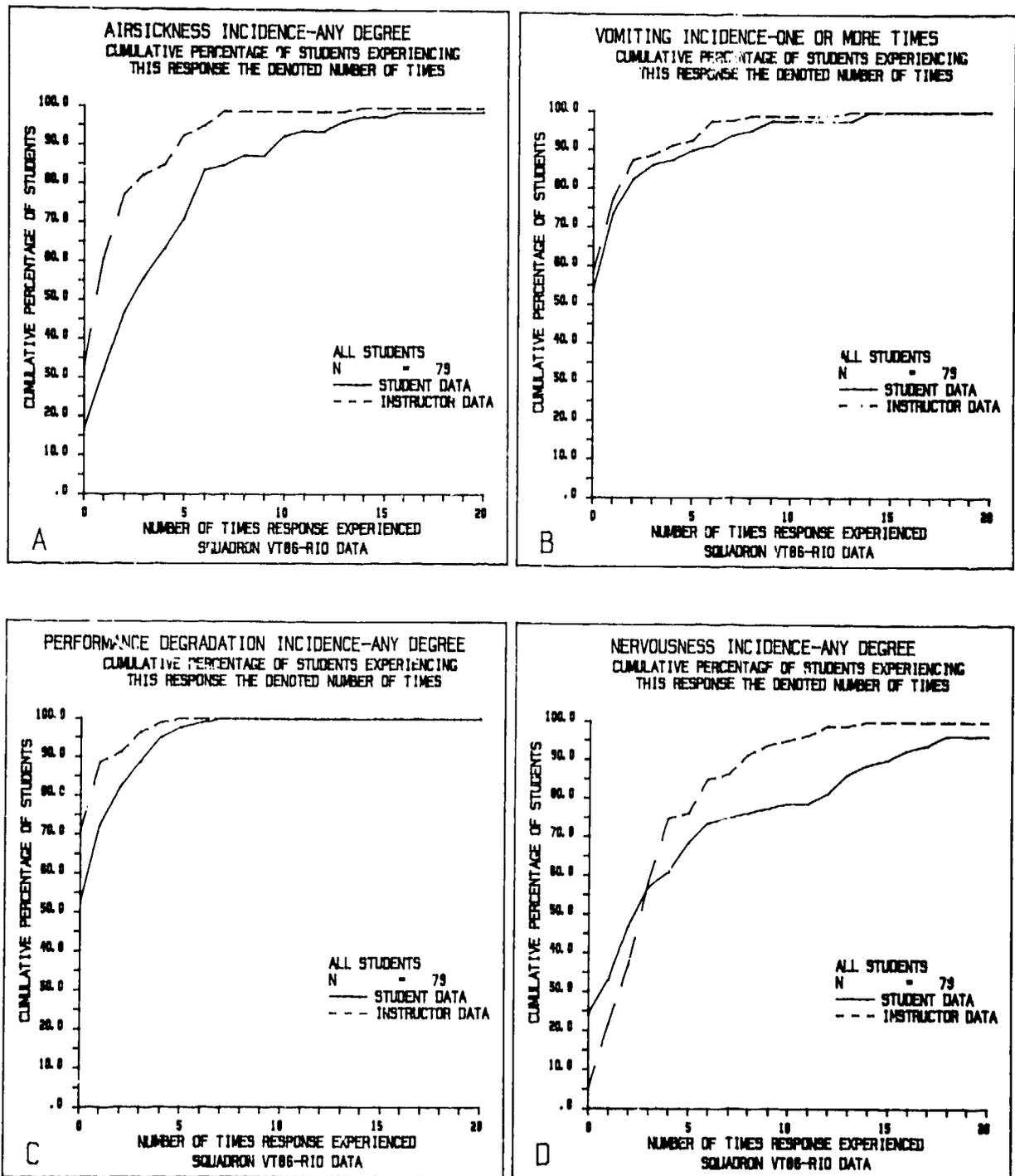
Figure 11

Normalized cumulative frequency distribution of students experiencing airsickness (A), vomiting (B), inflight performance degradation (C), and nervousness (D) a different number of times during the course of their flight training in this squadron based upon both student (solid line) and instructor (dashed line) data.

weighted indices were calculated for each student, using the airsickness, vomiting, performance degradation, nervousness, and medication usage components of the student questionnaire as measurement references. Similarly, for the instructor data pertaining to the same student, five unweighted and five weighted indices were calculated, using the same measurement references, with the one exception of substituting the instructor rating of turbulence for the student report of medication usage. Flight indices were not calculated for those students who submitted less than four questionnaires during the study period.
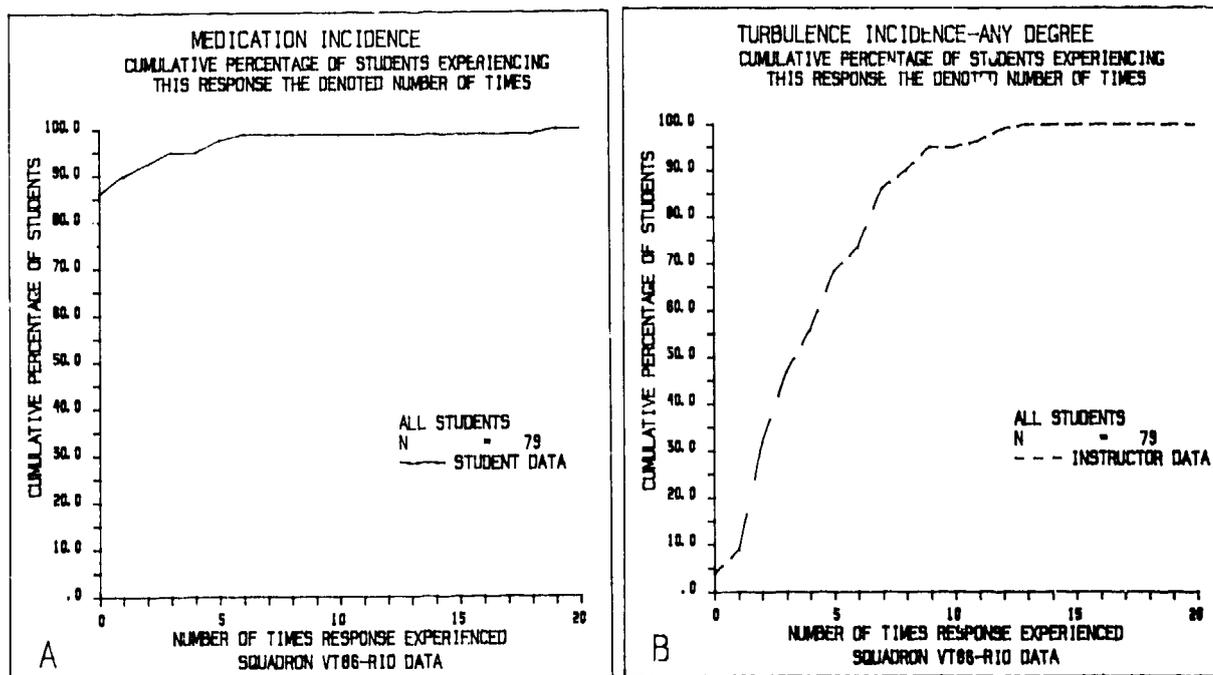
Figure 12

Normalized cumulative frequency distribution of students utilizing medication on a repeated basis (A) and students experiencing turbulence or roughness of air on one or more flights (B). Note that the incidence of medication usage shown in Figure 8 was accounted for by a very small percentage of the total student population, as indicated in A.

The methods used to calculate the indices were keyed to structuring a computer data storage file for each student that contained a sequential tabulation of all questionnaires collected from the student during the course of his squadron training. The unweighted indices were calculated from this file as

1) RESPONSE INDEX (UNWEIGHTED) = $\dfrac{\text{No. Flights Response Experienced}}{\text{Total No. Flights Flown}} \times 100$

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where no weight was given to the severity of the response; i.e., attention was given only to the fact that a response such as airsickness occurred on a flight without regard to its mild, moderate, or severe degree of magnitude. Accordingly, the unweighted indices simply represent the percentage of the flights flown by the student where the denoted response such as airsickness occurred. This method of calculation of the unweighted indices was applied to each of the five student questionnaire responses and to each of the five instructor responses, as listed above.

The weighted indices calculated for the same ten questionnaire responses were based upon the assignment of a linear weight of 0, 1, 2, 3 to the four magnitude ratings associated with all but the medication usage item. For example, if a student reported that he was not airsick on a hop, he would have a response rating of 0.0 for this particular flight; a student who reported either mild, moderate, or severe airsickness was given a response rating of 1, 2, or 3, respectively, for a particular hop. These response ratings were summed for all of the hops flown by a given student and used to calculate a weighted index that was normalized to have a maximum value of 100 as follows:

$$2) \quad \text{RESPONSE INDEX (WEIGHTED)} = \frac{\text{Sum (Individual Flight Response Ratings)}}{\text{Total No. Flights Flown}} \times \frac{100}{3}$$

To illustrate, a student who was never airsick during training would have a weighted airsickness response index of 0.0; a student who was severely airsick on all of his flights would have a corresponding weighted index of 100.0; a student who was mildly airsick on 50 percent of his flights would have an index of 16.7; and a student who was severely airsick on 50 percent of his flights would have an index of 50.0. In the case of the medication usage question, a response rating of 0 was assigned to the item if medication was not used on the flight, and 1 if used. The weighted index was also normalized to have a maximum value of 100.0, thus resulting in the unweighted and weighted indices for this one item being identical.

The resulting group statistics for the response indices of the VT86-RIO students are presented in Table III. Statistical parameters listed for each response variable include the group mean, standard deviation of the observations, standard error of the mean, minimum and maximum values observed, group median, the total number of observations (students) in the data base, and the Kolmogorov-Smirnov deviation statistic. Response variables 1 through 10 in this table represent the response indices derived from the student-based questionnaire data; variables 11 through 20 correspond equivalently to the indices derived from the instructor-based questionnaire data; variables 21 and 22 are the final academic and flight grades, respectively, received by the students upon graduating from basic training in Squadron VT10; and variables 42 and 43 are the final academic and flight grades received by those students who successfully completed advanced training in VT86-RIO.

Variables 23 through 41 in Table III describe the performance of the student group on assorted elements of the motion reactivity test

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Table III

Statistical listing of the flight response indices and laboratory test scores for the Squadron VT86-RIO study population. Data presented for each response variable include the mean, standard deviation, standard error of the mean, minimum, maximum, median, and total number of students. In addition, the deviation-statistic associated with the nonparametric Kolmogorov-Smirnov one-sample test of goodness of fit of the distribution of the observed data to the distribution of an equivalent theoretical Gaussian population is listed at the right.

NO.	RESPONSE VARIABLE DESCRIPTION	MEAN	S.DEV.	S.ERR.	MIN	MAX	MEDIAN	N	DEV
1	S-AIRSICKNESS INDEX-UW	18.0	20.4	2.3	.0	100.0	11.7	78	.220
2	S-VOMITING INDEX-UW	7.3	14.2	1.6	.0	70.0	.0	78	.310
3	S-P.DEGRADATION INDEX-UW	5.2	8.7	1.0	.0	50.0	.0	78	280
4	S-NERVOUSNESS INDEX-UW	22.7	26.8	3.0	.0	100.0	12.5	78	.220
5	S-MEDICATION INDEX-UW	3.0	11.4	1.3	.0	79.2	.0	78	.490
6	S-AIRSICKNESS INDEX-W	8.1	10.2	1.2	.0	60.0	4.9	78	.230
7	S-VOMITING INDEX-W	4.2	8.4	1.0	.0	39.4	.0	78	.300
8	S-P.DEGRADATION INDEX-W	2.2	3.9	.4	.0	23.3	.0	78	.250
9	S-NERVOUSNESS INDEX-W	8.9	11.3	1.3	.0	52.1	4.3	78	.260
10	S-MEDICATION INDEX-W	3.0	11.4	1.3	.0	79.2	.0	78	.490
11	I-AIRSICKNESS INDEX-UW	8.3	11.7	1.3	.0	66.7	4.2	77	.250
12	I-VOMITING INDEX-UW	5.4	11.3	1.3	.0	66.7	.0	77	.290
13	I-P.DEGRADATION INDEX-UW	2.8	7.1	.8	.0	37.5	.0	77	.350
14	I-NERVOUSNESS INDEX-UW	15.9	12.1	1.4	.0	60.0	12.1	77	.19
15	I-TURBULENCE INDEX-UW	18.4	11.0	1.3	.0	60.0	16.7	77	.11
16	I-AIRSICKNESS INDEX-W	3.6	5.3	.6	.0	26.2	1.6	77	.230
17	I-VOMITING INDEX-W	3.2	7.2	.8	.0	40.7	.0	77	.270
18	I-P.DEGRADATION INDEX-W	1.3	3.7	.4	.0	25.0	.0	77	.350
19	I-NERVOUSNESS INDEX-W	6.4	5.6	.6	.0	33.3	4.8	77	.200
20	I-TURBULENCE INDEX-W	8.4	5.0	.6	.0	22.6	7.7	77	.10
21	ACADEMIC GRADES-BASIC	54.3	4.7	.5	43.9	68.0	54.3	79	.06
22	FLIGHT GRADES-BASIC	3.0	.0	.0	3.0	3.1	3.0	79	.110
23	TMSQ1-MS HISTORY:PART 1	9.1	10.4	1.2	.0	48.0	6.7	73	.160
24	TMSQ2-MS HISTORY:PART 2	5.6	7.8	.9	.0	36.0	3.0	73	.230
25	TMSQ3-MS HISTORY:SUM	14.7	15.9	1.9	.0	83.2	11.3	73	.200
26	TSANX-STATE/ANX.QUEST.	32.0	11.7	2.5	20.0	67.0	28.5	22	.22
27	TTANX-TRAIT/ANX.QUEST.	27.9	6.2	1.3	20.0	43.0	26.5	22	.16
28	TBVDT-BVDT TIME OF DAY	9.7	1.8	.2	7.7	15.6	9.5	73	.140
29	TBVDR-BVDT RATER	13.0	6.5	.8	7.0	38.3	11.4	73	.250
30	TBVDS-BVDT SELF-RATING	13.2	6.2	.7	5.0	33.0	12.0	73	.120
31	TBVDP-BVDT POST-RATING	6.2	19.9	2.4	.0	132.0	.0	68	.390
32	TVVSP1-VVIT STATIC-RIGHT	122.2	7.1	1.4	100.0	129.0	123.0	25	.20
33	TVVSP2-VVIT STATIC-WRONG	4.5	5.1	1.0	.0	18.0	3.0	25	.20
34	TVVSP3-VVIT STATIC-OMIT	2.3	3.2	.6	.0	9.0	.0	25	.350
35	TVVDP1-VVIT DYNAMIC-RIGHT	67.0	30.4	6.1	30.0	129.0	55.0	25	.19
36	TVVDP2-VVIT DYNAMIC-WRONG	8.9	7.4	1.5	.0	36.0	9.0	25	.15
37	TVVDP3-VVIT DYNAMIC-OMIT	53.1	29.9	6.0	.0	93.0	63.0	25	.10
38	TVVIR-VVIT RATER	18.0	8.2	1.6	7.5	33.5	17.0	25	.17
39	TVVIS-VVIT SELF-RATING	15.4	6.0	1.2	6.0	28.0	16.0	25	.09
40	TVVIP-VVIT POST-RATING	12.3	22.9	4.6	.0	100.0	5.0	25	.340
41	TVVIT-VVIT TIME OF DAY	10.0	1.8	.4	7.3	13.5	10.1	25	.15
42	ACADEMIC GRADES-ADVANCED	91.7	3.8	.4	76.7	99.2	92.3	78	.12
43	FLIGHT GRADES-ADVANCED	3.0	.0	.0	2.9	3.1	3.0	79	.090

S = STUDENT RESPONSE DATA   UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA   W = WEIGHTED RESPONSE INDEX
@ = SIGNIFICANT BEYOND THE .1 LEVEL
# = SIGNIFICANT BEYOND THE .01 LEVEL

battery given to many of the students prior to their beginning flight
training in Squadron VT10.   In brief, TMSQ1, TMSQ2, and TMSQ3 (variables
23, 24, and 25, respectively) pertain to a motion sickness history where
TMSQ1 and TMSQ2 involve motion sickness experiences prior to and follow-
ing age 12, with TMSQ3 equal to the sum of the TMSQ1 and TMSQ2 scores;
TSANX and TTANX (variables 26 and 27) to a state/trait anxiety test;
TBVDT, TBVDR, TBVDS, and TBVDP (variables 28 through 31) to a Brief
Vestibular Disorientation Test (BVDT); TVVSP1, TVVSP2, and TVVSP3 (vari-
ables 32 through 34) to the static performance element of a Visual/Vestibular
Interaction Test (VVIT); TVVDP1, TVVDP2, and TVVDP3 (variables 35 through
37) to the dynamic performance element of the VVIT; and TVVIR, TVVIS,
TVVIP, and TVVIT (variables 38 through 41) to the motion sickness rating
element of the VVIT.

In the interpretation of the numerical magnitude of the mean data
presented in Table III, it should be realized that for the 20 flight
indices, high scores denote poor performance and low scores good performance
(or in the case of the turbulence measure, high scores represent greater
stress than low scores).   Correspondingly, for the majority of the
motion reactivity test battery scores, high scores denote either poor
performance or greater susceptibility to motion stress. In the case of
two test scores (TVVSP1 and TVVDP1), the converse is true in that these
two variables pertain to the number of correct responses produced by the
students while performing the related test tasks. In the case of the
TBVDT and TVVIT variables, no magnitude relationship exists relative to
performance in that these measures describe the time of day (24-hour
clock) that the BVD and VVI Tests were given to the student group. The
converse relationship also applies to the grade data (variables 21, 22,
42, and 43) where higher scores obviously denote better student performance.

As with the questionnaire data collected previously (3,4), the
distributions of the 20 Squadron VT86-RIO flight indices are generally
skewed toward the lower values of the response scale, with the median
values of Table III consistently falling below the related means.
Similarly, the results of a Kolmogorov-Smirnov one-sample test of goodness
of fit (2) of the normalized cumulative distribution of the observed
data to an equivalent Gaussian distribution with the same mean and
standard deviation as the observed data indicate non-normality for the
majority of the data. As indicated by the significance symbols adjacent
to the Kolmogorov-Smirnov deviation statistic labeled as DEV in Table
III, the null hypothesis that the distribution of the observed data is
the same as a Gaussian distribution must be rejected at the .01 significance
level or greater for 17 of the 20 flight indices. Plots of the normalized
cumulative frequency distributions of the unweighted and weighted flight
indices, along with their equivalent theoretical Gaussian distributions,
are presented in Figures C1 through C5 of Appendix C for both the student-
and instructor-derived questionnaire data. Figures C6 through C11 plot
similar data for the motion reactivity test results (variables 23 through
41) of the squadron students.

The unweighted, student-based indices in Table III imply that for
this specific VT86-RIO population, the mean or "average" student experienced
airsickness on 18.0 percent of the hops flown, vomited one or more times

on 7.3 percent of the hops, experienced inflight performance degradation
due to airsickness on 5.2 percent of the hops, and reported the presence
of nervousness on 22.7 percent of the hops. The equivalent unweighted
indices calculated from the instructor-furnished data indicate considerably
lower mean values for the corresponding variables. This same relationship
applies to the weighted indices presented in Table III. The mean value of
3.0 for the medication usage index denotes the relatively low usage of
medication in the squadron. However, as mentioned in the first report (3)
such "average-student" interpretations of the Table III mean data are highly
restricted by the non-Gaussian nature of the related distributions.

COMPARISON OF GRADUATED/ATTRITED STUDENT PERFORMANCE

To compare the flight and laboratory performance of the VT86-RIO
students who were graduated from this squadron with those students who
attrited during training in this squadron, a Kruskal-Wallis one-way
analysis of variance by ranks test (2) was applied to the data associated
with these two subpopulations. This nonparametric statistical approach
was selected because of the non-Gaussian nature of the majority of the
inflight response indices and the motion reactivity test scores. In
Table IV a tabulation is made of the Kruskal-Wallis $\underline{H}$ statistic corrected
for tied ranks; and, for each of the two student groups, the mean,
standard deviation of the observations, standard error of the mean, and
number of students in the group. To reject the null hypothesis that
the graduated and attrited students derive from a common population requires
that the $\underline{H}$ statistic equal or exceed 3.84 at the .05 significance level,
6.64 at the .01 level, or 10.83 at the .001 level, assuming that $\underline{H}$ is
distributed like chi square with one degree of freedom. In conformance
with the analytical procedures established by the first report (3) of the
series, a probability of .01 was arbitrarily selected as the minimum degree
of statistical significance that would be symbolically identified in this
table. (This choice also applies to all following tables in this report.)

Table IV indicates that there were significant differences between
the graduated and attrited student groups for 18 of the 20 flight indices,
the only exceptions involving the turbulence measure. For example, the
mean data associated with the unweighted airsickness index (variable 1)
indicate that the students who attrited during VT86-RIO training were
airsick on 55.3 percent of their flights compared to 13.9 percent for the
students who graduated from the squadron. The differences between the two
groups were significant to the .001 level or better for both the unweighted
(variable 1) and weighted (variable 6) airsickness indices derived from
the student data. Equally significant differences were found for the
unweighted and weighted student judgments of nervousness (variables 4 and
9, respectively); and for the unweighted and weighted instructor judgments of
inflight performance degradation caused by airsickness (variables 13 and 18,
respectively). For this squadron, there appears to be a strong relation-
ship between the incidence and severity of airsickness experienced during
flight training and attrition. This is in contrast to the findings reported
(3) for Squadron VT10 where no significant differences were detected between
the two populations for any of the airsickness-related measures; and to the
findings reported (4) for VT86-AJN where the only difference involved the
student-based unweighted airsickness index (variable 1) and this difference

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Table IV

Results of a nonparametric Kruskal-Wallis one-way analysis of variance comparison of students who graduated from Squadron VT86-R10 with students who attrited from the squadron after beginning flight training.

NO.	RESPONSE VARIABLE DESCRIPTION	H STATISTIC	GRADUATES				ATTRITES			
			MEAN	S.DEV.	S.ERR.	N	MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	13.91*	13.7	14.8	1.7	70	55.3	29.1	10.3	8
2	S-VOMITING INDEX-UW	8.960	4.7	9.5	1.1	70	30.9	25.1	8.9	8
3	S-P.DEGRADATION INDEX-UW	9.490	3.4	5.2	.6	70	20.6	16.2	5.7	8
4	S-NERVOUSNESS INDEX-UW	11.77*	10.6	23.2	2.8	70	58.6	30.7	10.9	8
5	S-MEDICATION INDEX-UW	10.660	1.0	9.8	1.2	70	13.4	10.8	6.7	8
6	S-AIRSICKNESS INDEX-W	14.09*	5.8	5.7	.7	70	28.3	17.4	6.2	8
7	S-VOMITING INDEX-W	8.960	2.4	4.6	.6	70	19.6	16.2	5.7	8
8	S-P.DEGRADATION INDEX-W	9.930	1.4	1.9	.2	70	9.7	7.5	2.6	8
9	S-NERVOUSNESS INDEX-W	12.23*	6.9	8.8	1.1	70	26.1	16.3	5.7	8
10	S-MEDICATION INDEX-W	10.660	1 8	9.8	1.2	70	13.4	10.8	6.7	8
11	I-AIRSICKNESS INDEX-UW	9.730	6.2	7.9	.9	70	29.3	21.0	7.9	7
12	I-VOMITING INDEX-UW	7.350	3.5	7.0	.8	70	24.4	24.4	9.2	7
13	I-P.DEGRADATION INDEX-UW	12.18*	1.3	2.7	.3	70	18.5	15.4	5.8	7
14	I-NERVOUSNESS INDEX-UW	9.190	14.0	10.0	1.2	70	34.4	16.4	6.2	7
15	I-TURBULENCE INDEX-UW	3.66	17.4	9.7	1.2	70	28.3	18.3	6.9	7
16	I-AIRSICKNESS INDEX-W	9.730	2.6	3.3	.4	70	13.7	9.6	3.6	7
17	I-VOMITING INDEX-W	7.890	1.8	3.5	.4	70	16.9	16.5	6.2	7
18	I-P.DEGRADATION INDEX-W	12.33*	.5	1.0	.1	70	9.3	8.9	3.4	7
19	I-NERVOUSNESS INDEX-W	8.400	5.6	4.3	.5	70	15.1	9.5	3.6	7
20	I-TURBULENCE INDEX-W	2.54	8.1	4.7	.6	70	11.5	7.0	2.6	7
21	ACADEMIC GRADES-BASIC	7.710	54.8	4.6	.5	70	50.2	3.8	1.3	9
22	FLIGHT GRADES-BASIC	7.340	3.1	.0	.0	70	3.0	.0	.0	9
23	TMSQ1-MS HISTORY:PART 1	.23	9.3	11.0	1.4	64	8.2	5.2	1.7	9
24	TMSQ2-MS HISTORY:PART 2	2.63	5.3	7.8	1.0	64	7.7	7.7	2.6	9
25	TMSQ3-MS HISTORY:SUM	.96	14.6	16.7	2.1	64	15.8	9.7	3.2	9
26	TSANX-STATE/ANX.QUEST.	2.36	30.1	9.2	2.1	19	43.7	20.8	12.0	3
27	TTANX-TRAIT/ANX.QUEST.	.02	28.9	6.4	1.5	19	27.0	5.0	2.9	3
28	TBVDT-BVDT TIME OF DAY	.51	9.8	1.8	.2	64	9.2	1.1	.4	9
29	TBVDR-BVDT RATER	4.99	12.5	6.1	.8	64	16.5	8.0	2.7	9
30	TBVDS-BVDT SELF-RATING	5.35	12.4	5.4	.7	64	10.8	8.3	2.8	9
31	TBVDP-BVDT POST-RATING	1.06	4.6	13.1	1.7	61	20.4	49.2	18.6	7
32	TVVSP1-VVIT STATIC-RIGHT	1.58	122.9	7.1	1.5	22	117.7	5.8	3.3	3
33	TVVSP2-VVIT STATIC-WRONG	1.37	4.2	5.4	1.2	22	6.3	2.3	1.3	3
34	TVVSP3-VVIT STATIC-OMIT	3.43	1.9	3.0	.6	22	5.0	3.5	2.0	3
35	TVVDP1-VVIT DYNAMIC-RIGHT	.34	68.6	31.7	6.8	22	55.0	17.3	10.0	3
36	TVVDP2-VVIT DYNAMIC-WRONG	.25	8.8	7.9	1.7	22	9.3	.6	.3	3
37	TVVDP3-VVIT DYNAMIC-OMIT	.45	31.5	31.2	6.6	22	64.7	17.0	9.8	3
38	TVVIR-VVIT RATER	1.58	17.4	8.2	1.7	22	22.3	8.4	4.8	3
39	TVVIS-VVIT SELF-RATING	.45	16.0	5.8	1.2	22	19.0	8.2	4.7	3
40	TVVIP-VVIT POST-RATING	3.31	8.5	14.7	3.1	22	40.7	51.5	29.7	3
41	TVVIT-VVIT TIME OF DAY	.06	10.8	1.8	.4	22	9.8	1.7	1.0	3

S = STUDENT RESPONSE DATA   UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA   W = WEIGHTED RESPONSE INDEX
0 = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

was significant to only the .05 level.

Table IV also indicates that the final academic and flight grades received upon graduation from primary training in Squadron VT10 for the two populations were significantly different, with the mean grade level lowest for the attrite group. Relative to the 19 laboratory test scores, differences significant to the .05 or better level were found for only the rater (variable 29) and self-rating (variable 30) elements of the BVDT. In both cases the mean scores for the attrite group were higher (implying a higher degree of motion reactivity) than those for the graduated group. In the case of the VVIT scores (variables 32-41) the total number of attrite students who were exposed to this test was too low to permit any evaluation of the results.

COMPARISON OF STUDENT SUBPOPULATIONS BASED UPON AIRSICKNESS SENSITIVITY

In the first report (3) of the series it was emphasized that a long-term objective of this laboratory is to develop and validate an airsickness test battery to identify both susceptible and nonsusceptible aviation candidates. In this study, the inflight data derived from both the students and the instructors over the full course of the NFO training syllabus serve to quantitatively distinguish between those students who repeatedly suffer airsickness (high flight index scores) and those students who rarely experience airsickness (low flight index scores). Accordingly, separation of the students into susceptible and nonsusceptible groups based upon their actual flight performance provides some direct insight into the relative merit of the individual components of the prototype motion reactivity test battery given to the students prior to their beginning NFO flight training. In the paragraphs that follow, such an approach is pursued by comparing the flight and laboratory data produced by the most susceptible students (arbitrarily defined as those students with high scores falling into the upper decile of the entire population for a given airsickness measure) with those produced by the least susceptible students (arbitrarily defined as those students who never experienced airsickness during training). In the interpretation of the data afforded by these comparisons, it must be recognized, however, that as training progresses through the various basic, advanced, and fleet readiness squadrons, the flight index level that defines the upper decile population during the early phases of training should be greater than the level that defines the upper decile population during the later phases of training. That is, natural screening of airsick-prone individuals through either attrition during basic training or selection of minimal flight stress pipelines following completion of basic training, combined with some degree of motion sickness adaptation, should result in a higher proportion of nonsusceptible students during the subsequent advanced and RAG squadron phases of the over-all training program. It would then follow that the mean values of the flight indices would be expected to fall as training progressed.

As with the first report (3) of the series, the initial comparison to be made involves the weighted airsickness index data derived from the student questionnaire (variable 6). The nonsusceptible population was

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defined as those students who never reported experiencing airsickness
during flight training in Squadron VT86-RIO. This corresponds to airsickness
index scores of 0.0 for both the unweighted (variable 1) and weighted
(variable 6) responses. The susceptible or airsick population was
defined as those 10 percent of the student population who had a weighted
airsickness index that equaled or exceeded the 90th centile (upper
decile) reference established by the normalized cumulative frequency
distribution for this particular index. The student-based distribution
data presented in Figure C1-B indicate that at the 90th-centile point,
the weighted index score was approximately 19.8. These distribution
data also indicate that the nonairsick group included approximately 15
percent of the total squadron population for which airsickness index
scores were determined.

With these criteria serving to define the airsick susceptible and
nonairsick susceptible populations, a Kruskal-Wallis one-way analysis of
variance was performed on each of the response variables, the results of
which are tabulated in Table V. As indicated by the significance symbols
entered adjacent to the H statistic, the airsickness-related flight
indices (variables 1-3, 6-8, 11-13, and 16-18) were significantly dif-
ferent for the two populations, which, by definition, would occur as a
result of the criterion selected to distinguish between the two populations.
The medication index also shows a higher drug usage rate for the airsick
group. Differences were also observed for all of the nervousness-related
indices but not for the instructor-based turbulence data. No differences
between the academic and flight grades received by the two groups, either
in basic training (variables 21 and 22) or advanced training (variables 42
and 43), were observed.

In the case of the 19 motion-reactivity test scores, statistical
differences were found only for two elements of the motion sickness case
history (variables 24 and 25). These same variables showed similar poten-
tial to distinguish between airsick susceptible and nonsusceptible stu-
dents in both the VT10 study (3) and the VT86-AJN study (4). Again, the
N value associated with the VVIT battery is not large enough to permit
evaluation of the results.

Table VI provides a similar comparison between students with a high
(upper decile) weighted vomit index (variable 7) and students who never
reported vomiting on their training flights. This latter group, repre-
senting approximately 52 percent of the squadron population for which
student-based weighted vomit index scores were available, includes both
those Table V students who were never airsick and thus never vomited,
and those students who were occasionally airsick but never reported vomit-
ing. The upper decile, as derived from the Figure C2-B distribution data,
for the susceptible student group was marked by a weighted vomit index
score of approximately 12.2. As indicated in Table VI, all flight indices
with the exceptions of the instructor ratings of nervousness and turbu-
lence were significantly different for the two populations. In the case
of the laboratory test scores, no significant differences between the two
populations were found for either the motion sickness case history scores
or the BVDT scores. For the remaining tests, the N values were too low
for evaluation.

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Table V

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never experienced airsickness during flight training with students who had a relatively high incidence of airsickness. The nonairsick group, defined as those students with a weighted airsickness index (variable 6 from the student questionnaire) equal to 0.0, represented approximately 15 percent of the total study population. The airsick group, arbitrarily established as the most sensitive 10 percent of the students, was defined as those individuals with a weighted airsickness index equal to or greater than 19.8 which marked the upper decile for this measure.

RESPONSE VARIABLE		H	NONAIRSICK				AIRSICK			
NO.	DESCRIPTION	STATISTIC	MEAN	S.DEV.	S.ERR.	N	MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	17.47*	.0	.0	.0	12	64.6	20.2	7.1	8
2	S-VOMITING INDEX-UW	14.46*	.0	.0	.0	12	36.6	22.1	7.8	8
3	S-P.DEGRADATION INDEX-UW	14.46*	.0	.0	.0	12	23.3	14.0	4.9	8
4	S-NERVOUSNESS INDEX-UW	12.94*	5.9	11.2	3.2	12	59.8	29.1	10.3	8
5	S-MEDICATION INDEX-UW	7.82#	.0	.0	.0	12	12.0	19.1	6.8	8
6	S-AIRSICKNESS INDEX-W	17.47*	.0	.0	.0	12	31.8	13.7	4.8	8
7	S-VOMITING INDEX-W	14.46*	.0	.0	.0	12	22.0	14.6	5.2	8
8	S-P.DEGRADATION INDEX-W	14.46*	.0	.0	.0	12	10.3	6.7	2.4	8
9	S-NERVOUSNESS INDEX-W	12.94*	2.1	3.8	1.1	12	26.0	16.0	5.6	8
10	S-MEDICATION INDEX-W	7.82#	.0	.0	.0	12	12.0	19.1	6.8	8
11	I-AIRSICKNESS INDEX-UW	16.82*	.0	.0	.0	12	36.0	16.7	6.3	7
12	I-VOMITING INDEX-UW	13.60*	.0	.0	.0	12	31.6	22.0	8.3	7
13	I-P.DEGRADATION INDEX-UW	13.60*	.0	.0	.0	12	20.0	13.7	5.2	7
14	I-NERVOUSNESS INDEX-UW	11.46*	8.9	6.7	1.9	12	34.1	13.1	4.9	7
15	I-TURBULENCE INDEX-UW	4.03	14.2	6.0	1.7	12	28.7	16.6	6.3	7
16	I-AIRSICKNESS INDEX-W	16.82*	.0	.0	.0	12	16.0	7.8	3.0	7
17	I-VOMITING INDEX-W	13.60*	.0	.0	.0	12	19.6	14.9	5.6	7
18	I-P.DEGRADATION INDEX-W	13.60*	.0	.0	.0	12	9.7	8.4	3.2	7
19	I-NERVOUSNESS INDEX-W	11.46*	3.3	2.8	.8	12	14.7	8.7	3.3	7
20	I-TURBULENCE INDEX-W	4.12	6.6	2.4	.7	12	11.2	6.2	2.4	7
21	ACADEMIC GRADES-BASIC	1.52	53.8	4.9	1.4	12	50.2	3.7	1.3	8
22	FLIGHT GRADES-BASIC	2.92	3.1	.0	.0	12	3.0	.8	.0	8
23	TMSQ1-MS HISTORY:PART 1	4.78	2.2	4.2	1.2	12	12.2	15.4	5.5	8
24	TMSQ2-MS HISTORY:PART 2	13.06*	.3	1.2	.3	12	13.2	12.2	4.3	8
25	TMSQ3-MS HISTORY:SUM	8.96#	2.6	5.2	1.5	12	25.4	25.3	8.9	8
26	TSANX-STATE/ANX.QUEST.	.00	.0	.0	.0	1	52.0	21.2	15.0	2
27	TTANX-TRAIT/ANX.QUEST.	1.50	.0	.0	.0	1	29.5	3.5	2.5	2
28	TBVDT-BVDT TIME OF DAY	2.15	10.6	2.3	.7	12	9.3	1.1	.4	8
29	TBVDR-BVDT RATER	.79	14.9	11.2	3.2	12	15.8	9.0	3.2	8
30	TBVDS-BVDT SELF-RATING	2.16	13.2	7.0	2.0	12	18.4	8.6	3.0	8
31	TBVDP-BVDT POST-RATING	.57	1.1	2.3	.7	11	19.9	49.5	18.7	7
32	TVVSP1-VVIT STATIC-RIGHT	1.50	.0	.0	.0	1	116.0	7.1	5.0	2
33	TVVSP2-VVIT STATIC-WRONG	1.50	.0	.0	.0	1	7.0	2.8	2.0	2
34	TVVSP3-VVIT STATIC-OMIT	1.50	.0	.0	.0	1	6.0	4.2	3.0	2
35	TVVDP1-VVIT DYNAMIC-RIGHT	1.50	.0	.0	.0	1	60.0	21.2	15.0	2
36	TVVDP2-VVIT DYNAMIC-WRONG	2.00	.0	.0	.0	1	9.0	.0	.0	2
37	TVVDP3-VVIT DYNAMIC-OMIT	1.53	.0	.0	.0	1	60.0	21.2	15.0	2
38	TVVIR-VVIT RATER	1.50	.0	.0	.0	1	25.0	9.9	7.0	2
39	TVVIS-VVIT SELF-RATING	1.50	.0	.0	.0	1	22.5	7.8	5.5	2
40	TVVIP-VVIT POST-RATING	1.50	.0	.0	.0	1	57.0	60.8	43.0	2
41	TVVIT-VVIT TIME OF DAY	1.50	.0	.0	.0	1	10.8	.3	.2	2
42	ACADEMIC GRADES-ADVANCED	1.03	90.6	4.8	1.2	12	92.9	1.8	1.2	2
43	FLIGHT GRADES-ADVANCED	2.17	3.0	.0	.0	12	3.0	.0	.0	2

S = STUDENT RESPONSE DATA   UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA   W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

Table VI

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported vomiting during flight training with students who reported a relatively high incidence of vomiting. The non-vomit group, defined as those students with a weighted vomit index (variable 7 from the student questionnaire data) equal to 0.0, represented approximately 52 percent of the study population. The vomit group was defined as those students with a weighted vomit index equal to or greater than 12.2 which marked the upper decile for this measure.

RESPONSE VARIABLE NO. DESCRIPTION	H STATISTIC	NONVOMIT				VOMIT			
		MEAN	S.DEV.	S.ERR.	N	MEAN	S.DEV.	S.ERR.	N
1 S-AIRSICKNESS INDEX-UW	17.06*	10.1	14.4	2.3	41	56.5	21.8	7.7	8
2 S-VOMITING INDEX-UW	47.50*	.0	.0	.0	41	44.4	14.9	5.3	8
3 S-P DEGRADATION INDEX-UW	20 06*	1.2	2.8	.4	41	20.6	14.5	5.1	8
4 S-NERVOUSNESS INDEX-UW	9.200	17.7	23.1	3.6	41	49.6	29.7	10.5	8
5 S-MEDICATION INDEX-UW	22.56*	.1	.5	.1	41	0.2	0.5	3.0	8
6 S-AIRSICKNESS INDEX-W	19.02*	3.7	4.8	.8	41	29.5	13.5	5.5	8
7 S-VOMITING INDEX-W	47.58*	.0	.0	.0	41	26.2	9.3	3.3	8
8 S-P DEGRADATION INDEX-W	20.06*	.5	1.8	.2	41	9.4	7.0	2.5	8
9 S-NERVOUSNESS INDEX-W	9.620	6.5	8.5	1.3	41	22.6	16.8	5.9	8
10 S-MEDICATION INDEX-W	22.56*	.1	.5	.1	41	8.2	0.5	3.0	8
11 I-AIRSICKNESS INDEX-UW	19.47*	2.9	4.1	.6	41	35.8	17.2	6.5	7
12 I-VOMITING INDEX-UW	46.62*	.0	.0	.0	41	33.5	19.0	7.2	7
13 I-P DEGRADATION INDEX-UW	37.36*	.2	.8	.1	41	10.9	12.9	4.9	7
14 I-NERVOUSNESS INDEX-UW	6.47	14.3	12.3	1.9	41	28.3	11.5	4.3	7
15 I-TURBULENCE INDEX-UW	.34	10.1	11.6	1.8	41	20.0	:9.0	3.8	7
16 I-AIRSICKNESS INDEX-W	19.74*	1.1	1.6	.2	41	16.5	7.3	2.0	7
17 I-VOMITING INDEX-W	46.62*	.0	.0	.0	41	20.4	13.9	5.3	7
18 I-P DEGRADATION INDEX-W	37.36*	.1	.3	.0	41	8.9	8.3	3.1	7
19 I-NERVOUSNESS INDEX-W	6.32	5.0	6.1	1.0	41	11.3	5.1	1.9	7
20 I-TURBULENCE INDEX-W	.00	8.1	4.8	.7	41	7.9	4.4	1.7	7
21 ACADEMIC GRADES-BASIC	.90	54.4	4.9	.0	41	52.7	4.3	1.5	8
22 FLIGHT GRADES-BASIC	1.67	3.1	.0	.0	41	3.0	.0	.0	8
23 TMSQ1-MS HISTORY PART 1	2.72	6.6	7.8	1.2	40	13.8	14.4	5.1	8
24 TMSQ2-MS HISTORY PART 2	3.02	4.2	6.9	1.1	40	8.7	11.6	4.1	8
25 TMSQ3-MS HISTORY SUM	2.45	10.8	13.6	2.2	40	22.5	25.9	9.1	8
26 TSANX-STATE/ANX QUEST.	5.60	29.2	8.4	2.7	10	53.0	15.1	8.7	3
27 TTANX-TRAIT/ANX QUEST.	.03	29.3	7.7	2.4	10	27.7	4.0	2.3	3
28 TBVDT-BVDT TIME OF DAY	1.17	9.0	1.8	.3	40	9.0	.9	.3	8
29 TBVDR-BVDT RATER	3.71	11.9	6.5	1.0	40	16.6	8.8	3.1	8
30 TBVDS-BVDT SELF-RATING	2.04	11.8	5.3	.8	40	16.5	9.0	3.2	8
31 TBVDP-BVDT POST-RATING	.07	2.1	5.2	.9	37	23.4	49.1	18.6	7
32 TVVSP1-VVIT STATIC-RIGHT	.78	123.5	7.2	2.3	10	120.2	7.4	3.7	4
33 TVVSP2-VVIT STATIC-WRONG	.20	3.4	4.2	1.3	10	4.2	3.8	1.9	4
34 TVVSP3-VVIT STATIC-OMIT	1.59	2.1	3.5	1.1	10	4.5	3.9	1.9	4
35 TVVDP1-VVIT DYNAMIC-RIGHT	.02	66.5	30.7	9.7	10	69.2	42.8	21.4	4
36 TVVDP2-VVIT DYNAMIC-WRONG	.61	10.5	10.2	3.2	10	6.5	3.3	1.7	4
37 TVVDP3-VVIT DYNAMIC-OMIT	.05	52.0	29.7	9.4	10	53.2	0.6	20.3	4
38 TVVIR-VVIT RATER	4.58	14.4	6.8	2.2	10	24.4	6.0	3.0	4
39 TVVIS-VVIT SELF-RATING	1.64	14.9	4.8	1.5	10	19.2	6.1	3.0	4
40 TVVIP-VVIT POST-RATING	4.73	2.9	4.8	1.5	10	32.0	45.6	22.8	4
41 TVVIT-VVIT TIME OF DAY	.72	10.9	1.9	.6	10	10.3	1.1	.5	4
42 ACADEMIC GRADES-ADVANCED	1.39	91.4	4.5	.7	39	93.3	.8	.5	3
43 FLIGHT GRADES-ADVANCED	1.56	3.0	.0	.3	39	3.0	.0	.0	3

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

In like manner, a Kruskal-Wallis one-way analysis of variance was applied to two student groups distinguished by the amount of inflight performance degradation experienced as a result of airsickness. As indicated in the heading of Table VII, the nonsusceptible student group was defined by those students who never reported the incidence of performance degradation. This group represented approximately 51 percent of the total population. The susceptible group was defined by those students with a weighted performance degradation index (variable 8) that equaled or exceeded the upper decile score of approximately 6.2 as derived from the Figure C3-B distribution data. Significant differences between the two populations were found for all flight indices except the weighted turbulence measure. In the case of the laboratory test scores, significant differences were observed for only the self-rating element of the BVDT, and this was at the .05 level. As with the two previous comparisons, neither the academic and flight grades received during basic training nor the same grades received upon graduation from this advanced squadron served to distinguish between the two populations.

Table VIII presents a corresponding analysis based upon the weighted nervousness index scores. The upper decile used to identify the highly nervous population was marked by a weighted nervousness index score (variable 9) of approximately 25.7 as derived from the Figure C4-B distribution data. The non-nervous group, i.e., the students who reported they never experienced nervousness during flight training, included only 23 percent of the total population. In this case, the only significant differences in the flight indices outside the nervousness measure involved the student ratings of airsickness and performance degradation, with the mean scores lowest for the non-nervous population. For the laboratory test data, no significant differences between the two populations were observed.

In Tables V through VIII, the classification criteria used to define the susceptible and nonsusceptible populations were based upon flight indices derived from the student judgments of their own experiences. It should be recognized that the classification criteria could also be derived from the instructor judgments of student flight performance. This is demonstrated by Table IX which is identical to Table V, with the exception that the airsick and nonairsick populations are defined by the instructor-based weighted airsickness index (variable 16) instead of the corresponding student-based index (variable 6). With this instructor-based airsickness index, the highly susceptible (upper decile) population was defined as those students who had a weighted airsickness index equal to or greater than 9.6 as derived from the Figure C1-D distribution data. The low susceptibility group for the instructor-based population subdivision (students judged by the instructors to have never experienced airsickness during training in VT86-AJN) included approximately 32 percent of the squadron population. It should be noted that the nonairsick student group defined by the students proper included only 15 percent of the population, again reflecting the general underestimation of airsickness by the instructors. A comparison of the Table IX data with the Table V data indicates that the same flight indices were found to significantly distinguish between the two populations. In the case of the laboratory test battery scores, no significant differences between the populations

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Table VII

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported experiencing <u>performance degradation</u> due to airsickness with students who reported a relatively high incidence of performance degradation. The non-affected group, defined as those students with a weighted performance degradation index (variable <u>8</u> from the <u>student</u> questionnaire data) equal to 0.0, represented approximately 51 percent of the study population. The affected group was defined as those students with a weighted performance degradation index equal to or greater than 6.2 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NO PER. DEGRADATION MEAN	S.DEV.	S.ERR.	N	HIGH PER. DEGRADATION MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	17.50*	9.3	14.3	2.3	40	55.5	22.1	7.8	8
2	S-VOMITING INDEX-UW	25.12*	1.6	4.9	.8	40	34.8	21.1	7.5	8
3	S-P.DEGRADATION INDEX-UW	46.49*	.0	.0	.0	40	25.9	10.5	3.7	8
4	S-NERVOUSNESS INDEX-UW	14.89*	15.1	20.5	3.2	40	62.3	30.2	10.7	8
5	S-MEDICATION INDEX-UW	18.71*	.3	1.6	.3	40	14.6	18.2	6.4	8
6	S-AIRSICKNESS INDEX-W	18.68*	3.5	5.0	.8	40	29.5	15.2	5.4	8
7	S-VOMITING INDEX-W	26.46*	.7	2.2	.4	40	21.6	13.8	4.9	8
8	S-P.DEGRADATION INDEX-W	46.49*	.0	.0	.0	40	11.6	5.1	1.8	8
9	S-NERVOUSNESS INDEX-W	13.88*	5.9	8.6	1.4	40	26.7	15.8	5.6	8
10	S-MEDICATION INDEX-W	18.71*	.3	1.6	.3	40	14.6	18.2	6.4	8
11	I-AIRSICKNESS INDEX-UW	19.26*	3.0	4.7	.7	40	31.9	17.8	6.7	7
12	I-VOMITING INDEX-UW	25.25*	1.0	2.4	.4	40	29.0	20.9	7.9	7
13	I-P.DEGRADATION INDEX-UW	29.49*	.2	.8	.1	40	20.0	13.7	5.2	7
14	I-NERVOUSNESS INDEX-UW	7.90#	14.0	12.4	2.0	40	29.1	11.8	4.5	7
15	I-TURBULENCE INDEX-UW	7.65#	16.4	11.2	1.8	40	27.0	6.7	2.5	7
16	I-AIRSICKNESS INDEX-W	19.26*	1.2	1.9	.3	40	15.0	8.0	3.0	7
17	I-VOMITING INDEX-W	25.62*	.5	1.3	.2	40	19.0	14.5	5.5	7
18	I-P.DEGRADATION INDEX-W	29.49*	.1	.3	.0	40	9.8	8.3	3.2	7
19	I-NERVOUSNESS INDEX-W	6.77#	5.8	6.2	1.0	40	11.6	5.0	1.9	7
20	I-TURBULENCE INDEX-W	6.61	7.5	4.6	.7	40	11.9	3.9	1.5	7
21	ACADEMIC GRADES-BASIC	3.13	54.2	5.4	.8	40	50.9	3.4	1.2	8
22	FLIGHT GRADES-BASIC	1.30	3.1	.0	.0	40	3.0	.0	.0	8
23	TMSQ1-MS HISTORY,PART 1	.06	7.2	9.6	1.6	37	6.2	5.8	2.1	8
24	TMSQ2-MS HISTORY,PART 2	3.89	3.2	5.3	.9	37	8.1	9.1	3.2	8
25	TMSQ3-MS HISTORY,SUM	1.15	10.4	12.4	2.0	37	14.3	11.1	3.9	8
26	TSANX-STATE/ANX.QUEST.	3.75	29.4	8.4	2.6	10	32.0	21.2	15.0	2
27	TTANX-TRAIT/ANX.QUEST.	.01	29.9	7.5	2.4	10	29.5	3.5	2.5	2
28	TBVDT-BVDT TIME OF DAY	.02	9.6	1.7	.3	37	9.2	.8	.3	8
29	TBVDR-BVDT RATER	1.49	12.8	7.4	1.2	37	16.0	9.0	3.2	8
30	TBVDS-BVDT SELF-RATING	4.29	12.4	5.8	1.0	37	15.1	8.7	3.1	8
31	TBVDP-BVDT POST-RATING	3.27	1.4	2.9	.5	34	20.3	49.3	18.6	7
32	TVVSP1-VVIT STATIC-RIGHT	2.03	123.5	6.8	2.1	11	116.0	7.1	5.0	2
33	TVVSP2-VVIT STATIC-WRONG	1.04	3.6	4.0	1.2	11	7.0	2.8	2.0	2
34	TVVSP3-VVIT STATIC-OMIT	2.07	1.9	3.4	1.0	11	6.0	4.2	3.0	2
35	TVVDP1-VVIT DYNAMIC-RIGHT	.16	73.5	34.9	10.5	11	60.0	21.2	15.0	2
36	TVVDP2-VVIT DYNAMIC-WRONG	.35	9.5	10.0	3.0	11	9.0	.0	.0	2
37	TVVDP3-VVIT DYNAMIC-OMIT	.35	46.0	33.1	10.0	11	60.0	21.2	15.0	2
38	TVVIR-VVIT RATER	1.40	17.3	8.8	2.7	11	25.0	9.9	7.0	2
39	TVVIS-VVIT SELF-RATING	1.92	15.0	4.5	1.3	11	22.5	7.8	5.5	2
40	TVVIP-VVIT POST-RATING	2.90	10.7	20.1	6.1	11	57.0	60.8	43.0	2
41	TVVIT-VVIT TIME OF DAY	.00	10.9	1.7	.5	11	10.8	.3	.2	2
42	ACADEMIC GRADES-ADVANCED	1.00	92.4	3.7	.6	38	90.0	2.0	1.4	2
43	FLIGHT GRADES-ADVANCED	1.00	3.0	.0	.0	38	3.0	.0	.0	2

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S = STUDENT RESPONSE DATA          UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA         W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL
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Table VIII

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never
reported experiencing nervousness before or during a flight with students who reported a rela-
tively high incidence of nervousness. The non-nervous group, defined as those students with a
weighted nervousness index (variable 9 from the student questionnaire data) equal to 0.0, repre-
sented approximately 23 percent of the study population. The nervous group was defined as those
students with a weighted nervousness index equal to or greater than 25.7 which marked the upper
decile for this measure.

RESPONSE VARIABLE NO. DESCRIPTION	H STATISTIC	NONNERVOUS MEAN	S.DEV.	S.ERR.	N	NERVOUS MEAN	S.DEV.	S.ERR.	N
1 S-AIRSICKNESS INDEX-UW	13.62*	6.1	7.2	1.7	18	42.9	24.6	8.7	8
2 S-VOMITING INDEX-UW	3.19	2.5	4.4	.8	18	13.3	17.4	6.2	8
3 S-P.DEGRADATION INDEX-UW	8.51●	1.2	2.4	6	18	14.3	11.9	4.2	8
4 S-NERVOUSNESS INDEX-UW	23.93*	.8	.8	.8	18	84.4	12.2	4.3	8
5 S-MEDICATION INDEX-UW	3.15	.4	1.1	.3	18	18.5	19.2	6.8	8
6 S-AIRSICKNESS INDEX-W	14.45*	2.4	2.6	.6	18	19.9	12.5	4.4	8
7 S-VOMITING INDEX-W	3.41	1.8	2.8	.5	18	8.8	12.7	4.5	8
8 S-P.DEGRADATION INDEX-W	8.51●	.5	.9	.2	18	5.9	5.4	1.9	8
9 S-NERVOUSNESS INDEX-W	23.94*	.8	.8	.8	18	35.3	8.7	3.1	8
18 S-MEDICATION INDEX-W	3.15	.4	1.1	.3	18	18.5	19.2	6.8	8
11 I-AIRSICKNESS INDEX-UW	6.62	3.5	4.7	1.1	18	17.5	14.7	5.2	8
12 I-VOMITING INDEX-UW	2.79	2.3	4.8	.9	18	12.8	16.2	5.7	8
13 I-P.DEGRADATION INDEX-UW	3.15	.4	1.2	.3	18	9.9	14.5	5.1	8
14 I-NERVOUSNESS INDEX-UW	6.26	8.7	4.7	1.1	18	24.1	18.1	6.4	8
15 I-TURBULENCE INDEX-UW	2.68	15.5	18.7	2.5	18	24.1	16.4	5.8	8
16 I-AIRSICKNESS INDEX-W	6.17	1.5	2.1	.5	18	8.5	8.7	3.1	8
17 I-VOMITING INDEX-W	3.44	1.1	2.8	.5	18	8.6	13.1	4.6	8
18 I-P.DEGRADATION INDEX-W	3.15	.2	.6	.1	18	4.4	6.3	2.2	8
19 I-NERVOUSNESS INDEX-W	4.24	3.4	1.7	.4	18	18.4	18.1	3.6	8
28 I-TURBULENCE INDEX-W	3.36	7.1	5.8	1.2	18	18.6	5.8	2.8	8
21 ACADEMIC GRADES-BASIC	2.97	56.3	5.6	1 3	18	52.6	4.4	1.5	8
22 FLIGHT GRADES-BASIC	5.53	3.1	.8	.8	18	3.8	.8	.8	8
23 TMSQ1-MS HISTORY.PART 1	.95	7.5	12.7	3.4	14	9.9	9.8	3.2	8
24 TMSQ2-MS HISTORY.PART 2	19	5.1	6 9	1.9	14	8.2	11.8	3.9	8
25 TMSQ3-MS HISTORY.SUM	.63	12.6	14.2	3.8	14	18.1	17.2	6.1	8
26 TSANX-STATE/ANX.QUEST.	.86	24.5	4.7	2.3	4	29.5	18.6	7.5	2
27 TTANX-TRAIT/ANX.QUEST.	.86	26.2	8.3	4.1	4	31.8	1.4	1.8	2
28 TBVDT-BVDT TIME OF DAY	4.48	9.2	1.8	.3	14	18.4	1.6	.5	8
29 TBVDR-BVDT RATER	3 16	18.3	2.3	.6	14	13.1	5.3	1.9	8
38 TBVDS-BVDT SELF-RATING	3.56	18.2	5.3	1.4	14	15.4	7.3	2.6	8
31 TBVDP-BVDT POST-RATING	.85	1.4	2.4	.6	14	1.4	2.3	.9	7
32 TVVSP1-VVIT STATIC-RIGHT	.24	123.7	7.1	3.5	4	128.8	12.7	5.8	2
33 TVVSP2-VVIT STATIC-WRONG	.86	3.7	4.5	2.2	4	4.5	6.4	4.5	2
34 TVVSP3-VVIT STATIC-OMIT	.67	1.5	3.8	1.5	4	4.5	6.4	4.5	2
35 TV'DP1-VVIT DYNAMIC-RIGHT	.86	79.8	38.5	19.3	4	48.5	4.9	3.5	2
36 TVVDP2-VVIT DYNAMIC-WRONG	.21	14.5	14.5	7.3	4	8.8	1.4	1.8	2
37 TVVDP3-VVIT DYNAMIC-OMIT	.86	35.5	35.7	17.8	4	72.5	3.5	2.5	2
38 TVVIR-VVIT RATER	.86	16.2	11.5	5.8	4	15.7	3.2	2.2	2
39 TVVIS-VVIT SELF-RATING	1.93	15.8	2.9	1.5	4	18.5	2.1	1.5	2
48 TVVIP-VVIT POST-RATING	.86	17.5	32.4	16.2	4	9.5	6.4	4.5	2
41 TVVIT-VVIT TIME OF DAY	1.93	11.2	1.2	.6	4	9.8	1.1	.8	2
42 ACADEMIC GRADES-ADVANCED	.59	92.8	3.9	.9	18	98.9	5.2	2.6	4
43 FLIGHT GRADES-ADVANCED	1.66	3.1	.8	.8	18	3.8	.1	.8	4

S = STUDENT RESPONSE DATA   UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA   W = WEIGHTED RESPONSE INDEX
● = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

Table IX

Results of a Kruskal-Wallis one-way analysis of variance comparison of students identified by the flight instructors as never being airsick with students identified by the instructors as having a relatively high incidence of airsickness (see Table V for an equivalent comparison based upon student judgments). The non-airsick group, defined as those students with a weighted airsickness index (variable 16 from the instructor questionnaire data) equal to 0.0, represented approximately 32 percent of the total study population. The airsick group was defined as those students with a weighted airsickness index equal to or greater than 9.6 which marked the upper decile for this measure.

	RESPONSE VARIABLE	H	NONAIRSICK				AIRSICK			
NO.	DESCRIPTION	STATISTIC	MEAN	S.DEV.	S.ERR.	N	MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	18.54*	3.9	4.8	1.0	25	58.7	15.3	5.4	8
2	S-VOMITING INDEX-UW	26.67*	.3	1.0	.2	25	35.6	16.4	5.8	8
3	S-P.DEGRADATION INDEX·UW	26.67*	.3	.9	.2	25	19.1	6.5	2.3	8
4	S-NERVOUSNESS INDEX-UW	11.33*	13.1	23.0	4.6	25	55.6	33.2	11.7	8
5	S-MEDICATION INDEX-UW	17.70*	.0	.0	.0	25	13.8	18.5	6.5	8
6	S-AIRSICKNESS INDEX-W	18.54*	1.6	2.0	.4	25	25.1	9.3	3.3	8
7	S-VOMITING INDEX-W	26.67*	.1	.3	.1	25	21.9	11.2	4.0	8
8	S-P.DEGRADATION INDEX-W	26.67*	.1	.5	.1	25	8.7	3.4	1.2	8
9	S-NERVOUSNESS INDEX-W	11.91*	4.7	8.3	1.7	25	24.8	16.9	6.0	8
10	S-MEDICATION INDEX-W	17.70*	.0	.0	.0	25	13.8	18.5	6.5	8
11	I-AIRSICKNESS INDEX-UW	31.21*	.0	.0	.0	25	35.2	15.5	5.5	8
12	I-VOMITING INDEX-UW	31.21*	9	.0	.0	25	30.7	19.2	6.8	8
13	I-P.DEGRADATION INDEX-UW	31.21*	.0	.0	.0	25	19.9	11.8	4.2	8
14	I-NERVOUSNESS INDEX-UW	9.68#	11.8	9.0	1.8	25	38.2	11.0	3.9	8
15	I-TURBULENCE INDEX·UW	3.04	14.2	8.9	1.8	25	21.7	10.4	3.7	8
16	I-AIRSICKNESS INDEX-W	31.21*	.0	.0	.0	25	16.1	6.7	2.4	8
17	I-VOMITING INDEX-W	31.21*	.0	.0	.0	25	19.6	12.9	4.6	8
18	I-P.DEGRADATION INDEX-W	31.21*	.0	.0	.0	25	9.4	7.7	2.7	8
19	I-NERVOUSNESS INDEX-W	8.66#	4.6	4.3	.9	25	12.2	4.9	1.7	8
20	I-TURBULENCE INDEX-W	2.42	6.4	4.0	.8	25	9.4	5.3	1.9	8
21	ACADEMIC GRADES-BASIC	1.92	54.0	5.4	1.1	23	50.7	5.0	1.8	8
22	FLIGHT GRADES-BASIC	3.63	3.0	.0	.0	25	3.0	.0	.0	8
23	TMSQ1-MS HISTORY PART 1	1.11	7.5	11.3	2.3	24	11.9	15.4	5.4	8
24	TMSQ2-MS HISTORY PART 2	3.83	3.2	6.8	1.4	24	10.4	13.5	4.8	8
25	TMSQ3-MS HISTORY SUM	1.66	10.7	15.6	3.2	24	22.3	27.2	9.6	8
26	TSANX-STATE/ANX.QUEST.	3.00	31.4	10.5	4.7	5	53.0	15.1	8.7	3
27	TTANX-TRAIT/ANX.QUEST.	.20	29.8	5.9	2.6	5	27.7	4.0	2.3	3
28	TBVDT-BVDT TIME OF DAY	.12	9.7	1.9	.4	24	9.1	.9	.3	8
29	TBVDR-BVDT RATER	4.11	12.5	8.2	1.7	24	16.5	8.7	3.1	8
30	TBVDS-BVDT SELF-RATING	2.27	12.4	6.2	1.3	24	18.1	9.4	3.3	8
31	TBVDP-BVDT POST-RATING	2.40	1.5	3.3	..	22	24.3	48.7	18.4	7
32	TVVSP1-VVIT STATIC-RIGHT	1.00	123.0	6.4	2.8	5	110.0	8.7	4.4	4
33	TVVSP2-VVIT STATIC-WRONG	.77	3.6	3.9	1.7	5	8.0	7.6	3.8	4
34	TVVSP3-VVIT STATIC-OMIT	.07	2.4	3.3	1.5	5	3.0	4.2	2.1	4
35	TVVDP1-VVIT DYNAMIC-RIGHT	1.50	64.6	28.8	12.9	5	87.2	35.3	17.6	4
36	TVVDP2-VVIT DYNAMIC-WRONG	.54	15.2	12.4	5.6	5	8.7	5.3	2.7	4
37	TVVDP3-VVIT DYNAMIC-OMIT	.96	49.2	30.6	13.7	5	33.0	33.9	16.9	4
38	TVVIR-VVIT RATER	.96	14.6	9.1	4.1	5	20.0	9.7	4.9	4
39	TVVIS-VVIT SELF-RATING	.24	16.4	7.2	3.2	5	17.7	8.2	4.1	4
40	TVVIP-VVIT POST-RATING	.99	4.4	7.7	3.4	5	31.5	46.1	23.0	4
41	TVVIT-VVIT TIME OF DAY	.54	10.6	2.1	.9	5	9.5	1.5	.8	4
42	ACADEMIC GRADES-ADVANCED	.79	91.9	4.5	.9	24	93.6	1.0	.6	3
43	FLIGHT GRADES-ADVANCED	1.74	3.0	.0	.0	24	3.0	.8	.0	3

S = STUDENT RESPONSE DATA   UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA   W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

were found. This also corresponds to the Table V findings.

FLIGHT AND LABORATORY DATA CORRELATIONS

To gain some insight into the relationships that may exist among
the response variables during this particular phase of NFO training, the
flight and laboratory data were examined, using a Spearman rank correla-
tion analysis corrected for tied scores. The results of this analysis
are presented in matrix form in Table X, with the total number of data
pairs associated with a given correlation coefficient within this matrix
tabulated in similar form in Table XI. Table X also lists the unity
value correlation of a variable with itself so as to establish the total
number of observations available for analysis. To establish the statistical
significance of the rank correlation coefficients, a t statistic was
calculated for each relationship and a standard two-tailed student t-
test table evaluation performed. Those correlations which the t-test
evaluation identified as being statistically significant at the .01 and
.001 levels or greater are identified accordingly in Table X. To facili-
tate the general interpretation of the relative strength of relationship
described by the magnitude of the correlations, the definitions of
Guilford (ref. 1, p. 145) as described below will be arbitrarily adopted
for discussion:

Less than .20	Slight; almost negligible relationship
.20-.40	Low correlation; definite but small relation-ship
.40-.70	Moderate correlation; substantial relation-ship
.70-.90	High correlations; marked relationship
.90-1.00	Very high correlations; very dependable relationship.

In the discussion that follows, reference will be made to only those
rank correlation coefficients that are statistically significant to the
.01 or better level.

As with the Squadron VT10 and Squadron VT86-AJN data, the Table X
rank correlation coefficients for the 20 Squadron VT86-RIO flight indices
show a considerable number of significant intercorrelations. For
example, very high correlations exist between the unweighted and weighted
indices for the student-based questionnaire data. The same applies
within the corresponding instructor-based flight indices. Considering
the three response variables that are, by definition, directly linked to
motion sickness, i.e., airsickness, vomiting, and performance degradation
due to airsickness, it can be observed in Table X that the correlations
between the corresponding student and instructor indices are in the
moderate to high ranges. Of these three variables, the student/instructor
correlations for corresponding indices are lowest for the performance
degradation measure; the highest correlations exist between the student/
instructor vomit indices which would be expected for this overt symptom.
There was also a substantial relationship between the students' judgment of
the severity of their airsickness experiences (variable 6) and the number of

34

NO.	RESPONSE VARIABLE DESCRIPTION	1	2	3	4	5	6	7	8	9
1	S-AIRSICKNESS INDEX-UW	1.00								
2	S-VOMITING INDEX-UW	.61*	1.00							
3	S-P.DEGRADATION INDEX-UW	.68*	.67*	1.00						
4	S-NERVOUSNESS INDEX-UW	.63*	.30#	.41*	1.00					
5	S-MEDICATION INDEX-UW	.39*	.45*	.37*	.26	1.00				
6	S-AIRSICKNESS INDEX-W	.97*	.67*	.72*	.61*	.41*	1.00			
7	S-VOMITING INDEX-W	.61*	.99*	.69*	.31#	.48*	.68*	1.00		
8	S-P.DEGRADATION INDEX-W	.67*	.67*	.99*	.41*	.37#	.72*	.69*	1.00	
9	S-NERVOUSNESS INDEX-W	.63*	.30#	.40*	.99*	.25	.61*	.31#	.41*	1.00
10	S-MEDICATION INDEX-W	.39*	.45*	.37*	.26	1.00	.41*	.48*	.37#	.25
11	I-AIRSICKNESS INDEX-UW	.77*	.70*	.69*	.42*	.42*	.79*	.70*	.68*	.43*
12	I-VOMITING INDEX-UW	.60*	.95*	.65*	.31#	.48*	.65*	.95*	.64*	.31#
13	I-P.DEGRADATION INDEX-UW	.49*	.70*	.63*	.27	.45*	.54*	.72*	.64*	.28
14	I-NERVOUSNESS INDEX-UW	.39*	.19	.20	.58*	.25	.36#	.20	.27	.58*
15	I-TURBULENCE INDEX-UW	.22	.09	.19	.18	.11	.21	.00	.20	.19
16	I-AIRSICKNESS INDEX-W	.75*	.72*	.69*	.39*	.45*	.77*	.73*	.68*	.48*
17	I-VOMITING INDEX-W	.60*	.95*	.65*	.31#	.49*	.66*	.96*	.66*	.32#
18	I-P.DEGRADATION INDEX-W	.50*	.71*	.64*	.26	.45*	.54*	.72*	.65*	.27
19	I-NERVOUSNESS INDEX-W	.36#	.23	.27	.55*	.24	.37*	.24	.27	.56*
20	I-TURBULENCE INDEX-W	.18	.00	.19	.20	.12	.18	.00	.20	.21
21	ACADEMIC GRADES-BASIC	-.15	-.01	-.00	-.34#	-.09	-.14	-.03	-.00	-.34#
22	FLIGHT GRADES-BASIC	-.23	-.12	-.13	-.39#	-.04	-.24	-.13	-.14	-.38#
23	TMSQ1-MS HISTORY:PART 1	.32#	.28	.14	.25	.15	.33#	.28	.16	.22
24	TMSQ2-MS HISTORY:PART 2	.39*	.29	.28	.17	.34#	.37#	.29	.27	.15
25	TMSQ3-MS HISTORY:SUM	.37#	.31#	.19	.21	.26	.37#	.31#	.20	.18
26	TSANX-STATE/ANX.QUEST.	.38	.41	.36	.34	.45	.42	.48	.36	.33
27	TTANX-TRAIT/ANX.QUEST.	.07	-.08	-.16	.18	.11	.06	-.07	-.10	.21
28	TBVDT-BVDT TIME OF DAY	-.13	-.05	.09	.06	-.06	-.12	-.08	.07	.07
29	TBVDR-BVDT RATER	.25	.33#	.17	.27	.27	.28	.34#	.18	.27
30	TBVDS-BVDT SELF-RATING	.30	.26	.15	.25	.17	.29	.25	.16	.23
31	TBVDP-BVDT POST-RATING	.12	.19	.23	-.02	.23	.17	.21	.24	-.04
32	TVVSP1-VVIT STATIC-RIGHT	-.09	-.19	-.19	-.24	-.48	-.14	-.24	-.23	-.24
33	TVVSP2-VVIT STATIC-WRONG	.11	.15	.16	.15	.37	.13	.20	.20	.18
34	TVVSP3-VVIT STATIC-OMIT	.01	.12	.09	.30	.56#	.06	.17	.11	.26
35	TVVDP1-VVIT DYNAMIC-RIGHT	.03	.05	-.02	-.19	-.23	.02	.05	-.05	-.17
36	TVVDP2-VVIT DYNAMIC-WRONG	-.27	-.12	.07	-.21	.12	-.15	-.05	.12	-.16
37	TVVDP3-VVIT DYNAMIC-OMIT	.07	.03	.08	.30	.23	.09	.02	.11	.27
38	TVVIR-VVIT RATER	.27	.48	.16	.34	.17	.26	.35	.13	.31
39	TVVIS-VVIT SELF-RATING	.12	.27	.08	.29	.03	.16	.19	.06	.27
40	TVVIP-VVIT POST-RATING	.27	.51	.27	.30	.20	.31	.44	.25	.27
41	TVVIT-VVIT TIME OF DAY	-.25	-.35	-.37	-.32	-.06	-.37	-.36	-.41	-.33
42	ACADEMIC GRADES-ADVANCED	.14	.15	-.11	-.07	.06	.09	.11	-.14	-.06
43	FLIGHT GRADES-ADVANCED	-.14	-.09	-.11	-.38#	-.01	-.16	-.10	-.11	-.36#

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table X

for the Squadron VT86-RIO flight and laboratory data based upon the Spearman rank correlation coefficient ad

									RESPONSE	VARIABLE							
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1.00																	
.42*1.00																	
.40*	.74*1.00																
.45*	.64*	.73*1.00															
.25	.34#	.21	.26 1.00														
.11	.30#	.12	.21	.31#1.00													
.45*	.98*	.77*	.67*	.30#	.27 1.00												
.49*	.74*	.99*	.75*	.21	.13	.78*1.00											
.45*	.65*	.74*1.00*	.25	.23	.68*	.75*1.00											
.24	.37\	.25	.26	.96*	.30#	.33#	.26	.25 1.00									
.12	.29#	.11	.18	.24	.94*	.26	.13	.20	.24 1.00								
-.09	-.03	.03	-.06	-.37#-.01	-.01	-.00	-.04	-.34#	.02 1.00								
-.04	-.15	-.11	-.06	-.42#	.02	-.13	-.11	-.05	-.41#	.02*	.52*1.00						
.15	.20	.21	.15	-.01	-.05	.21	.22	.16	-.04	.01	.05 -.09 1.00						
.34#	.29	.29	.26	-.00	-.04	.29	.29	.26	-.05	.01	.01	.00	.54*1.00				
.26	.25	.26	.20	.01	-.03	.26	.26	.21	-.04	.03	-.00	-.09	.90*	.60*1.00			
.45	.31	.42	.48	.23	.16	.41	.51	.46	.26	.07	-.23	-.12	.00	.00	.02 1.00		
.11	-.20	-.06	-.02	-.13	.26	-.17	-.06	-.04	-.17	.18	-.10	-.12	.17	.07	.16	.24 1.00	
-.06	-.01	-.06	-.04	-.14	-.12	-.00	-.10	-.05	-.11	-.07	.06	.01	-.17	-.07	-.15	-.26	-.29
.27	.25	.33#	.30	.17	.06	.27	.34#	.28	.21	.07	-.10	-.23	.17	.14	.16	.68*-.04	
.17	.13	.?1	.12	.14	.15	.15	.22	.12	.13	.19	-.07	-.13	.30#	.07	.25	.54#	.17
.23	.16	.15	.15	-.03	.05	.21	.10	.14	-.06	.07	.12	-.02	.22	.16	.26	.57#	.14
-.48	-.02	-.13	-.14	-.32	-.20	.00	-.13	-.18	-.34	-.18	.27	.47	-.06	-.24	-.14	-.01	-.30
.37	.01	.13	.18	.24	.07	-.02	.12	.23	.24	.09	-.22	-.30	-.07	.16	-.00	-.01	.29
.56#-.02	.02	-.01	.31	.39	-.04	.05	-.02	.31	.32	-.21	-.41	.22	.44	.32	.16	.31	
-.23	-.05	.10	.23	-.21	.25	-.02	.13	.22	-.20	.34	-.27	.24	.02	.14	.07	-.08	.07
.12	-.25	-.08	.01	.09	.07	-.18	-.06	.05	.15	.03	-.13	-.05	-.27	-.42	-.40	.15	.13
.23	.14	-.04	-.20	.21	-.25	.10	-.06	-.19	.21	-.33	.17	-.32	.00	-.00	.02	.07	-.06
.17	.32	.33	.34	.22	-.19	.33	.32	.32	.15	-.20	.03	-.25	.12	.29	.20	.21	-.19
.03	.07	.22	.19	.11	.10	.09	.19	.14	.09	.05	-.12	-.04	.16	.24	.19	.06	.17
.20	.32	.45	.44	.30	.06	.35	.41	.46	.36	.05	.06	.03	.05	.13	.04	.21	-.24
-.06	-.18	-.29	-.14	-.32	-.19	-.21	-.20	-.14	-.40	-.14	.02	.24	-.09	.04	.01	-.17	-.01
.06	.03	.14	.00	.00	.07	.00	.11	.09	-.04	.06	.24	.12	-.13	-.01	-.11	-.20	.37
-.01	-.17	-.05	-.07	-.40*	.12	-.14	-.07	-.07	-.42*	.15	.43*	.44*	.06	.06	.06	-.33	.31

2

coefficient adjusted for tied ranks.

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43

```
10
02  1.00
16   .24  1.00
15  -.26  -.29  1.00
16   .68*  -.04   .10  1.00
25   .54#  .17  -.15   .36* 1.00
26   .57#  .14  -.12   .39*  .51* 1.00
14  -.01  -.30   .22   .00   .26   .32  1.00
00  -.01   .29  -.30  -.11  -.19  -.31  -.92* 1.00
32   .16   .31  -.19   .07  -.05  -.00  -.76*  .50# 1.00
07  -.08   .07  -.19  -.36  -.00   .01   .07   .00  -.32  1.00
40   .15   .13  -.10   .03   .12  -.04  -.42   .47   .10  -.12  1.00
02   .07  -.06   .20   .34  -.01  -.02  -.05  -.13   .31  -.98* -.02  1.00
29   .21  -.19  -.00   .23  -.13   .13  -.03   .01   .17  -.18  -.55#  .28  1.00
19   .06   .17   .00   .07   .02   .11   .17  -.22   .06   .19  -.56# -.07   .61# 1.00
04   .21  -.24  -.09   .25  -.00   .24   .05  -.02   .00   .01  -.43   .06   .79*  .62* 1.00
01  -.17  -.01   .11  -.21   .01  -.19   .23  -.16  -.09   .20  -.06  -.21   .03   .02  -.21  1.00
11  -.20   37  -.15   .03   .05  -.21  -.03   .17  -.23   .48  -.03  -.49  -.00   .16   .01   .32  1.00
06  -.33   .31  -.10  -.14  -.13   .01   .04   .01   .03   .35   .06  -.38  -.12   .29  -.04   .30   .19  1.00
```

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3

RESPONSE VARIABLE									
NO. DESCRIPTION	1	2	3	4	5	6	7	8	9
1 S-AIRSICKNESS INDEX-UW	78								
2 S-VOMITING INDEX-UW	78	78							
3 S-P.DEGRADATION INDEX-UW	78	78	78						
4 S-NERVOUSNESS INDEX-UW	78	78	78	78					
5 S-MEDICATION INDEX-UW	78	78	78	78	78				
6 S-AIRSICKNESS INDEX-W	78	78	78	78	78	78			
7 S-VOMITING INDEX-W	78	78	78	78	78	78	78		
8 S-P.DEGRADATION INDEX-W	78	78	78	78	78	78	78	78	
9 S-NERVOUSNESS INDEX-W	78	78	78	78	78	78	78	78	78
10 S-MEDICATION INDEX-W	78	78	78	78	78	78	78	78	78
11 I-AIRSICKNESS INDEX-UW	77	77	77	77	77	77	77	77	77
12 I-VOMITING INDEX-UW	77	77	77	77	77	77	77	77	77
13 I-P.DEGRADATION INDEX-UW	77	77	77	77	77	77	77	77	77
14 I-NERVOUSNESS INDEX-UW	77	77	77	77	77	77	77	77	77
15 I-TURBULENCE INDEX-UW	77	77	77	77	77	77	77	77	77
16 I-AIRSICKNESS INDEX-W	77	77	77	77	77	77	77	77	77
17 I-VOMITING INDEX-W	77	77	77	77	77	77	77	77	77
18 I-P.DEGRADATION INDEX-W	77	77	77	77	77	77	77	77	77
19 I-NERVOUSNESS INDEX-W	77	77	77	77	77	77	77	77	77
20 I-TURBULENCE INDEX-W	77	77	77	77	77	77	77	77	77
21 ACADEMIC GRADES-BASIC	78	78	78	78	78	78	78	78	78
22 FLIGHT GRADES-BASIC	78	78	78	78	78	78	78	78	78
23 TMSQ1-MS HISTORY.PART 1	72	72	72	72	72	72	72	72	72
24 TMSQ2-MS HISTORY.PART 2	72	72	72	72	72	72	72	72	72
25 TMSQ3-MS HISTORY:SUM	72	72	72	72	72	72	72	72	72
26 TSANX-STATE/ANX.QUEST.	21	21	21	21	21	21	21	21	21
27 TTANX-TRAIT/ANX.QUEST.	21	21	21	21	21	21	21	21	21
28 TBVDT-BVDT TIME OF DAY	72	72	72	72	72	72	72	72	72
29 TBVDR-BVDT RATER	72	72	72	72	72	72	72	72	72
30 TBVDS-BVDT SELF-RATING	72	72	72	72	72	72	72	72	72
31 TBVDP-BVDT POST-RATING	67	67	67	67	67	67	67	67	67
32 TVVSP1-VVIT STATIC-RIGHT	24	24	24	24	24	24	24	24	24
33 TVVSP2-VVIT STATIC-WRONG	24	24	24	24	24	24	24	24	24
34 TVVSP3-VVIT STATIC-OMIT	24	24	24	24	24	24	24	24	24
35 TVVDP1-VVIT DYNAMIC-RIGHT	24	24	24	24	24	24	24	24	24
36 TVVDP2-VVIT DYNAMIC-WRONG	24	24	24	24	24	24	24	24	24
37 TVVDP3-VVIT DYNAMIC-OMIT	24	24	24	24	24	24	24	24	24
38 TVVIR-VVIT RATER	24	24	24	24	24	24	24	24	24
39 TVVIS-VVIT SELF-RATING	24	24	24	24	24	24	24	24	24
40 TVVIP-VVIT POST-RATING	24	24	24	24	24	24	24	24	24
41 TVVIT-VVIT TIME OF DAY	24	24	24	24	24	24	24	24	24
42 ACADEMIC GRADES-ADVANCED	70	70	70	70	70	70	70	70	70
43 FLIGHT GRADES-ADVANCED	70	70	70	70	70	70	70	70	70

S = STUDENT RESPONSE DATA   UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA   W = WEIGHTED RESPONSE INDEX

Table XI

indicating the number of data-pairs used in the calculation of the Table X Spearman rank correlation coeffi

									RESPONSE	VARIABLE							
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
78																	
77	77																
77	77	77															
77	77	77	77														
77	77	77	77	77													
77	77	77	77	77	77												
77	77	77	77	77	77	77											
77	77	77	77	77	77	77	77										
77	77	77	77	77	77	77	77	77									
77	77	77	77	77	77	77	77	77	77								
77	77	77	77	77	77	77	77	77	77	77							
78	77	77	77	77	77	77	77	77	77	77	79						
78	77	77	77	77	77	77	77	77	77	77	79	79					
72	71	71	71	71	71	71	71	71	71	71	73	73	73				
72	71	71	71	71	71	71	71	71	71	71	73	73	73	73			
72	71	71	71	71	71	71	71	71	71	71	73	73	73	73	73		
21	21	21	21	21	21	21	21	21	21	21	22	22	22	22	22	22	
21	21	21	21	21	21	21	21	21	21	21	22	22	22	22	22	22	22
72	71	71	71	71	71	71	71	71	71	71	73	73	73	73	73	22	22
72	71	71	71	71	71	71	71	71	71	71	73	73	73	73	73	22	22
72	71	71	71	71	71	71	71	71	71	71	73	73	73	73	73	22	22
67	66	66	66	66	66	66	66	66	66	66	68	68	68	68	68	20	20
24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	22	22
24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	22	22
24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	22	22
24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	22	22
24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	22	22
24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	22	22
24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	22	22
24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	22	22
24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	22	22
70	70	70	70	70	70	70	70	70	70	70	70	70	64	64	64	19	19
70	70	70	70	70	79	70	70	70	70	70	70	70	64	64	64	19	19

Z

relation coefficients.

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
	22																	
	22	22																
	22	22	73															
	22	22	73	73														
	22	22	73	73	73													
	20	20	68	68	68	68												
	22	22	25	25	25	22	25											
	22	22	25	25	25	22	25	25										
	22	22	25	25	25	22	25	25	25									
	22	22	25	25	25	22	25	25	25	25								
	22	22	25	25	25	22	25	25	25	25	25							
	22	22	25	25	25	22	25	25	25	25	25	25						
	22	22	25	25	25	22	25	25	25	25	25	25	25					
	22	22	25	25	25	22	25	25	25	25	25	25	25	25				
	22	22	25	25	25	22	25	25	25	25	25	25	25	25	25			
	22	22	25	25	25	22	25	25	25	25	25	25	25	25	25	25		
	19	19	64	64	64	61	22	22	22	22	22	22	22	22	22	22	70	
	19	19	64	64	64	61	22	22	22	22	22	22	22	22	22	22	70	70

3

times they vomited (variable 7) as marked by a positive correlation of
.68. The instructor judgments of airsickness severity (variable 16) and
the number of times vomiting occurred (variable 17) were also well linked,
having a correlation of .78. The extent of the inflight performance
degradation caused by airsickness was also moderately correlated with
airsickness severity for both the student and instructor ratings. These
findings in Squadron VT86-RIO are in essential agreement with those
previously reported for Squadrons VT10 (3) and VT86-AJN (4).

In the case of the VT86-AJN data, the weighted nervousness indices
(variables 9 and 19) had no significant correlations with any of the
airsickness-related flight indices other than their unweighted counter-
parts. The VT86-RIO data do indicate, however, low-to-moderate correla-
tions between these indices. Significant but low correlations also existed
between the medication usage index and the unweighted and weighted airsick-
ness-related measures for both the student and instructor data. For the
turbulence measure, the only significant relationship found involved the
unweighted, instructor-based airsickness index.

The Table X correlation matrix can also be used to determine relation-
ships that existed between the flight data (variables 1 through 20) and
the laboratory test scores (variables 23 through 41). Although full
evaluation of the relative merit of each test as a predictive measure of
airsickness susceptibility must await completion of the entire data
collection phase of the longitudinal study, a few points will be discussed
for this advanced training squadron. First, all three of the motion
sickness history test scores have low but significant correlations with
the unweighted and weighted student-based measures of airsickness. One
of the motion sickness test scores (variable 24) had a low but significant
correlation with the medication index; a second test score (variable 25)
was similarly correlated with the student-based vomit indices. In addi-
tion, the BVDT rater score (variable 29) was correlated with the four
vomit indices.

It may also be observed in Table X that the advanced flight grade
index (variable 43) was correlated with the four nervousness indices.
Significant correlations also existed between the academic and flight
grades received in Squadron VT10; but not between the corresponding
grades received in VT86-RIO. The flight grades in VT86-RIO were corre-
lated, however, with the academic and flight grades received in VT10.

The Table X correlation matrix also serves to identify significant
inter- and intracorrelations that exist among and between the individual
laboratory tests. A cursory inspection of these relationships was performed
in the first report of the series (3) which involved a significantly larger
population that included the VT86-RIO students of the present study.

COMPARISON OF STUDENT PERFORMANCE: BASIC VT10 VERSUS
ADVANCED VT86-RIO

A generalized comparison of the airsickness problem encountered in
this advanced training squadron with that experienced during basic
training in Squadron VT10 can be gained from the Table I and Table II

data presented in this report and from the corresponding tables from the first report (3) of the series. These tables describe airsickness incidence and severity for each hop of the squadron flight syllabus and the distribution of students having repeated airsickness during the course of training. The 79 students in Squadron VT86-RIO were also members of the student population studied in the VT10 report. However, these VT86-RIO students represented only one subgroup (approximately 20 percent) of 408 students for which flight data in the pre-1978 syllabus were collected during VT10 training.

The Table I data of the first report (3) indicated that during basic training in Squadron VT10, airsickness, vomiting, and inflight performance degradation due to airsickness occurred on 16.2, 6.9, and 10.7 percent, respectively, of the 5,394 hops flown by the students. The Table I data of the present study show that these categories of responses occurred on 15.7, 6.2, and 4.4 percent of the 2,048 hops flown by the VT86-RIO students. From this viewpoint, the incidence of airsickness did not change as the NFO students progressed from basic to advanced training. The same trend can be observed in comparing the Table II student distribution data presented for the two squadrons. During VT10 training, airsickness, vomiting, and performance degradation were experienced one or more times by 74.5, 39.2, and 58.6 percent, respectively, of the total student population. The corresponding VT86-RIO data indicate that these same responses were experienced by 83.5, 46.8, and 48.1 percent of the students.

These comparisons show the relative incidence of airsickness in the two squadrons. However, the comparisons are based upon group performance and do not reflect individual differences within each squadron. Although the unweighted and weighted flight indices presented in Table III of both reports provide a measure of individual student performance, the two tables cannot be directly compared since the VT10 data include a considerable number of students other than those who were assigned to advanced training in VT86-RIO. To circumvent this problem, a computer program was developed to permit direct access to the VT10 flight indices of only those students comprising the VT86-RIO study population. A Wilcoxon matched-pairs signed-ranks test (2) was then used to compare the basic and advanced training flight indices of the VT86-RIO students. The results of this test are presented in Table XII for all 20 of the flight indices. For each flight index, Table XII presents the $\underline{T}$ and $\underline{Z}$ statistics associated with the Wilcoxon test, the number of students for which there was a difference between the basic and advanced index scores; and the mean, standard deviation of the observations, standard error of the mean, and number of observations for both basic and advanced training.

Table XII indicates that only six of the 20 flight indices showed significant differences between basic and advanced training. These included the student-based airsickness indices and the instructor-based performance degradation and nervousness measures. The relative magnitudes of the mean data presented in Table XII for each level of training indicate that the incidence and severity of airsickness was greatest during advanced training in VT86-RIO. In the case of the instructor-based performance degradation and nervousness indices, the mean data indicate

38

Table XII

Wilcoxon matched-pairs signed-ranks comparison of the flight indices received by the study population during basic training in Squadron VT10 and advanced training in Squadron VT86-R10. For each flight index, listings are made of the $\underline{T}$ and $\underline{Z}$ statistics associated with the Wilcoxon test, the number of students for which there was a difference between the basic and advanced index scores; and the mean, standard deviation, standard error of the mean, and number of observations for both basic and advanced training.

NO.	RESPONSE VARIABLE DESCRIPTION	WILCOXON TEST			BASIC TRAINING				ADVANCED TRAINING			
		T	Z	N	MEAN	S.DEV.	S.ERR.	N	MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	625.0	-3.48*	69	11.7	12.4	1.4	78	10.0	20.4	2.3	78
2	S-VOMITING INDEX-UW	296.0	-1.94	42	4.8	9.2	1.0	78	7.3	14.2	1.6	78
3	S-P.DEGRADATION INDEX-UW	-505.	-2.04	54	7.6	10.1	1.1	78	5.2	8.7	1.0	78
4	S-NERVOUSNESS INDEX-UW	-973.	-1.91	72	26.9	25.2	2.9	78	22.7	26.8	3.0	78
5	S-MEDICATION INDEX-UW	57.0	-.57	16	2.4	8.4	.9	78	3.0	11.4	1.3	78
6	S-AIRSICKNESS INDEX-W	763.0	-2.66#	69	5.7	6.7	.8	78	8.1	10.2	1.2	78
7	S-VOMITING INDEX-W	246.5	-2.56	42	2.5	5.3	.6	78	4.2	8.4	1.0	78
8	S-P.DEGRADATION INDEX-W	-468.	-2.36	54	3.6	5.0	.6	78	2.2	3.9	.4	78
9	S-NERVOUSNESS INDEX-W	-975.	-2.06	73	11.2	11.3	1.3	78	8.9	11.3	1.3	78
10	S-MEDICATION INDEX-W	57.0	-.57	16	2.4	8.4	.9	78	3.0	11.4	1.3	78
11	I-AIRSICKNESS INDEX-UW	878.5	-.05	59	8.3	10.6	1.2	77	8.3	11.7	1.3	77
12	I-VOMITING INDEX-UW	375.0	-.72	41	4.7	9.1	1.0	77	5.4	11.3	1.3	77
13	I-P.DEGRADATION INDEX-UW	-285.	-3.52*	45	5.8	7.9	.9	77	2.8	7.1	.8	77
14	I-NERVOUSNESS INDEX-UW	883.5	-2.86#	75	11.2	11.7	1.3	77	15.9	12.1	1.4	77
15	I-TURBULENCE INDEX-UW	-1457	-.03	76	18.8	12.3	1.4	77	18.4	11.0	1.3	77
16	I-AIRSICKNESS INDEX-W	821.5	-.48	59	3.6	5.1	.6	77	3.6	5.3	.6	77
17	I-VOMITING INDEX-W	337.0	-1.21	41	2.2	4.7	.5	77	3.2	7.2	.8	77
18	I-P.DEGRADATION INDEX-W	-218.	-3.23#	44	2.4	3.8	.4	77	1.3	3.7	.4	77
19	I-NERVOUSNESS INDEX-W	853.5	-3.02#	75	4.4	4.9	.6	77	6.4	5.6	.6	77
20	I-TURBULENCE INDEX-W	-1127	-1.74	76	10.1	6.6	.8	77	8.4	5.9	.6	77

S = STUDENT RESPONSE DATA   UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA   W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

that these factors were greatest during basic training in VT10.

The conclusion that the airsickness problem in VT86-RIO was of larger magnitude than that observed for the same population in VT10 is in contrast to the findings for the VT86-AJN population which showed a decline in the incidence and severity of airsickness during advanced training. As reported previously for the VT86-AJN population (4), this decline in the magnitude of the airsickness problem as a student progresses through the over-all NFO flight training program could be attributed in part to the capability of an individual to gradually adapt to motion stress. It was emphasized, however, that consideration must be given to the relative level or magnitude of the actual motion stress associated with each squadron's flight syllabus. The increased magnitude of the airsickness problem experienced by the VT86-RIO population, who flew a flight syllabus generally considered to be more stressful than that flown by the VT86-AJN population, lends further support to this interpretation.

As discussed in the VT86-AJN report (4), it is of interest to determine if there is any predictive relationship between the magnitude of the airsickness difficulties a student experiences during the early phases of his flight training and the magnitude of the same difficulties he experiences during the later phases of his training. In effect, will those students who have the greatest problem with airsickness during basic training also have the greatest problem during advanced or RAG training? As a preliminary evaluation of this question for the VT86-RIO population, a Spearman rank correlation analysis corrected for tied observations was applied across the basic and advanced training flight indices received by the students. The resulting rank correlation coefficients are presented in matrix form at the top in Table XIII, with the number of data-pairs involved in each calculation listed correspondingly at the bottom.

An examination of the principal diagonal of Table XIII shows that statistically significant correlations between basic and advanced training were present for all ten of the student-based flight indices. The correlation coefficients for the unweighted airsickness and vomit indices were in the moderate range (.65 and .56, respectively) showing a substantial relationship between airsickness incidence in the two squadrons. The weighted indices for these same two measures were similarly correlated. The correlation coefficients for the other six student indices were lower but still signified a definite relationship between performance in the two squadrons. The three instructor-based airsick-related indices, both unweighted and weighted, were also significantly correlated across squadrons. The magnitude of the instructor-based correlations was slightly smaller than that for the corresponding student-based measures. For the instructor-based nervousness measures, there were no significant correlations across squadrons for any of the 20 flight indices. No correlations were found for the turbulence indices, which is as would be expected from the nature of this parameter.

The Table XIII matrix, by definition, also describes the interrelationship that exists between a given advanced training flight index and each

Table XIII

Correlation matrix for the flight indices received by the study population during basic training in Squadron VT86-RIO and advanced training in Squadron VT86-RIO based upon the Spearman rank correlation coefficient adjusted for tied ranks. Correlation coefficients at top and number of data-pairs at bottom.

ADVANCED SQUADRON
RESPONSE VARIABLE

BASIC SQUADRON
RESPONSE VARIABLE

NO	DESCRIPTION
1	S-AIRSICKNESS INDEX-UW
2	S-VOMITING INDEX-UW
3	S-P.DEGRADATION INDEX-UW
4	S-NERVOUSNESS INDEX-UW
5	S-MEDICATION INDEX-UW
6	S-AIRSICKNESS INDEX-UW
7	S-VOMITING INDEX-UW
8	S-P.DEGRADATION INDEX-W
9	S-NERVOUSNESS INDEX-W
10	S-MEDICATION INDEX-W
11	I-AIRSICKNESS INDEX-UW
12	I-VOMITING INDEX-UW
13	I-P.DEGRADATION INDEX-UW
14	I-NERVOUSNESS INDEX-UW
15	I-TURBULENCE INDEX-UW
16	I-AIRSICKNESS INDEX-UW
17	I-VOMITING INDEX-W
18	I-P.DEGRADATION INDEX-W
19	I-NERVOUSNESS INDEX-W
20	I-TURBULENCE INDEX-W
21	ACADEMIC GRADES
22	FLIGHT GRADES

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
* = SIGNIFICANT BEYOND THE .01 LEVEL
** = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

ADVANCED SQUADRON
RESPONSE VARIABLE

BASIC SQUADRON
RESPONSE VARIABLE

NO	DESCRIPTION
1	S-AIRSICKNESS INDEX-UW
2	S-VOMITING INDEX-UW
3	S-P.DEGRADATION INDEX-UW
4	S-NERVOUSNESS INDEX-UW
5	S-MEDICATION INDEX-UW
6	S-AIRSICKNESS INDEX-W
7	S-VOMITING INDEX-W
8	S-P.DEGRADATION INDEX-W
9	S-NERVOUSNESS INDEX-W
10	S-MEDICATION INDEX-W
11	I-AIRSICKNESS INDEX-UW
12	I-VOMITING INDEX-UW
13	I-P.DEGRADATION INDEX-UW
14	I-NERVOUSNESS INDEX-UW
15	I-TURBULENCE INDEX-UW
16	I-AIRSICKNESS INDEX-W
17	I-VOMITING INDEX-W
18	I-P.DEGRADATION INDEX-W
19	I-NERVOUSNESS INDEX-W
20	I-TURBULENCE INDEX-W
21	ACADEMIC GRADES
22	FLIGHT GRADES

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of the flight indices received during basic training. Again, most of these interindex correlations involve the three primary airsickness measures and the student-based nervousness indices. In general, the correlations that exist along the principal diagonal are greater than those that exist to either side in the matrix. These observations for Squadron VT86-RIO are in general agreement with those noted for Squadron VT86-AJN (4). No further interpretation of these data will be attempted until completion of the entire data collection phase of the longitudinal study.

REFERENCES

1. Guilford, J. P., Fundamental Statistics in Psychology and Education. Third Ed. New York/Toronto/London: McGraw-Hill, 1956.

2. Siegel, S., Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill, 1956.

3. Hixson, W. C., Guedry, F. E., Jr., Holtzman, G. L., Lentz, J. M., and O'Connell, P. F., Airsickness during Naval Flight Officer training: Basic Squadron VT-10. NAMRL-1258. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1979.

4. Hixson, W. C., Guedry, F. E., Jr., Holtzman, G. L., Lentz, J. M., and O'Connell, P. F., Airsickness during Naval Flight Officer training: Advanced Squadron VT86-AJN. NAMRL-1267. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1980.

APPENDIX A

Brief Description of Individual Hops Comprising the Advanced
Training Squadron VT86-RIO Flight Syllabus
(Pre-1978 Flight Syllabus)

VT86-RIO (Pre-1978 Syllabus)

AN-1, -2   Airways Navigation:
                              Primarily straight and level flight -
                                  no acrobatics

RT-1   T-39 Aircraft and Equipment Introduction:
                              Search technique

RT-2   Radar Operating Techniques and Pursuit
                                  Intercepts:
                              Counterturns, altitude corrections, rear
                                  quarter drift control

RT-3   Collision Course Correction Exercise:
                              Displacement turns, counterturns, altitude
                                  corrections

RT-4, -5, -6, -7, -8   Pursuit Intercepts:
                              Displacement turns (RT-8 check flight)

RT-9, -10, -11, -12, -13   Lead Collision Intercepts with Pursuit
                                  Reattacks:
                              Lead control and reattack intercept
                                  (R-13 check flight)

RT-14, -15, -16, -17   Forward Quarter Conversions with Pursuit
                                  Reattacks:
                              Conversion procedure with pursuit reattack
                                  (RT-17 check flight)

RT-18, -19, -20, -21   Unknown Intercepts:
                                  Reattack intercept (RT-21 check flight)

RT-22   Final Intercept Progress Check:
                                  All intercept maneuvers

D-1, -2, -3   TA-4J Familiarization:
                                  D-2 wingover, aileron rolls, barrel rolls
                                  D-3 loops, 1/2 Cuban eights, Immelmans,
                                      splits, and tactical formations

All flights flown in T-39D with the exception of D-1, -2, -3, which used the
TA-4J.

APPENDIX B

Brief Description of Laboratory Tests Comprising the 1977-1978
Prototype Motion Sickness Sensitivity Test Battery

Variable No.	Symbol Code	Test Description
23	TMSQ1	Two-part motion sickness history form describing motion
24	TMSQ2	sickness incidence and exposure level. TMSQ1 summar-
25	TMSQ3	izes the history before the age of 12 and has a minimum

Two-part motion sickness history form describing motion sickness incidence and exposure level. TMSQ1 summarizes the history before the age of 12 and has a minimum value of 0.0 denoting no problems and a maximum value of 180 denoting high susceptibility. TMSQ2 pertains to motion sickness experience following age 12 with the same minimum and maximum values. TMSQ3 is the numerical sum of the TMSQ1 and TMSQ2 scores. For details, see Reason, J. T., An investigation of some factors contributing to individual variation in motion sickness susceptibility. FPRC Committee Report 1277. London: Ministry of Defence, 1968.

26 TSANX
27 TTANX

This State-Trait Anxiety Inventory is comprised of two self-report scales. The State Anxiety scale (TSANX) reqires the individual to report how he feels at that particular moment in time, while the Trait Anxiety Scale (TTANX) requires the individual to report how he generally feels. Both scales have a minimum score of 20, denoting minimum anxiety and a maximum score of 80 denoting maximum anxiety. For details, see Spielberger, C. D., Gorsuch, R. L., and Lushene, R. E., STAI Manual for the State-Trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press, 1970.

28 TBVDT
29 TBVDR
30 TBVDS
31 TBVDP

Brief Vestibular Disorientation Test (BVDT) involving cross-coupled angular acceleration stimuli produced by paced head motions on a rotating chair. TBVDT denotes the time of day the test was given based upon a 24-hour decimal clock. TBVDR is the test score given by the rating panel and has a minimum value of 6 denoting no motion symptoms and a maximum value of 60 denoting a maximal motion sickness reaction. Immediately following the BVDT, each subject rated his own reactions to the test coded as TBVDS with a minimum score of 7 indicating no reaction and a maximum score of 49 denoting high reaction. A report of aftereffects was obtained from the subject 24 hours later and coded as TBVDP with a minimum score of 0 denoting no aftereffects and a maximum score of 180 denoting a high level of aftereffects. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.

Variable No.	Symbol Code	Test Description
32	TVVSP1	These scores pertain to the task performance element of
33	TVVSP2	the Visual-Vestibular Interaction Test (VVIT). The tasks
34	TVVSP3	involve the visual scan, acquisition and identification
		of a complex numerical display. Under static conditions,
		TVVSP1 denotes the number of correct responses, TVVSP2
		the number of incorrect responses, and TVVSP3 the number
		of omitted responses.
35	TVVDP1	The dynamic performance test scores TVVDP1, TVVDP2, and
36	TVVDP2	TVVDP3 describe the same response scores recorded while
37	TVVDP3	the subject undergoes passive sinusoidal rotation. For
		both the static and dynamic performance tests, the mini-
		mum scores within a given response category are 0 and
		129, respectively, with the further condition that sum
		of the correct, incorrect, and omitted scores must total
		129. For details, see Lentz, J. M., Holtzman, G. L.,
		Hixson, W. C., and Guedry, F. E., Normative data for two
		short tests of motion reactivity. NAMRL-1243. Pensacola,
		FL: Naval Aerospace Medical Research Laboratory, 1977.
38	TVVIR	These scores pertain to the motion sickness symptom rat-
39	TVVIS	ing element of the Visual-Vestibular Interaction Test
40	TVVIP	(VVIT). TVVIR is the test score given by the rating
41	TVVIT	panel and has a minimum value of 6 denoting no motion
		sickness symptoms and a maximum value of 60 denoting a
		maximal motion sickness reaction. Immediately following
		the VVIT, each subject rated his own reaction to the test,
		which was coded as TVVIS, with a minimum score of 7 de-
		noting no reaction and a maximum score of 70 denoting
		high reaction. A report of aftereffects was obtained
		from the subject approximately 24 hours later and coded
		as TVVIP with a minimum score of 0 denoting no after-
		effects. TVVIT denotes the time of day the test was ad-
		ministered based upon a 24-hour decimal clock. For
		details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C.,
		and Guedry, F. E., Normative data for two short tests of
		motion reactivity. NAMRL-1243. Pensacola, FL: Naval
		Aerospace Medical Research Laboratory, 1977.

Variable No.	Symbol Code	Test Description
32	TVVSP1	These scores pertain to the task performance element of
33	TVVSP2	the Visual-Vestibular Interaction Test (VVIT). The tasks
34	TVVSP3	involve the visual scan, acquisition and identification

of a complex numerical display. Under static conditions, TVVSP1 denotes the number of correct responses, TVVSP2 the number of incorrect responses, and TVVSP3 the number of omitted responses.

35	TVVDP1	The dynamic performance test scores TVVDP1, TVVDP2, and
36	TVVDP2	TVVDP3 describe the same response scores recorded while
37	TVVDP3	the subject undergoes passive sinusoidal rotation. For

both the static and dynamic performance tests, the minimum scores within a given response category are 0 and 129, respectively, with the further condition that sum of the correct, incorrect, and omitted scores must total 129. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.

38	TVVIR	These scores pertain to the motion sickness symptom rat-
39	TVVIS	ing element of the Visual-Vestibular Interaction Test
40	TVVIP	(VVIT). TVVIR is the test score given by the rating
41	TVVIT	panel and has a minimum value of 6 denoting no motion

sickness symptoms and a maximum value of 60 denoting a maximal motion sickness reaction. Immediately following the VVIT, each subject rated his own reaction to the test, which was coded as TVVIS, with a minimum score of 7 denoting no reaction and a maximum score of 70 denoting high reaction. A report of aftereffects was obtained from the subject approximately 24 hours later and coded as TVVIP with a minimum score of 0 denoting no after-effects. TVVIT denotes the time of day the test was administered based upon a 24-hour decimal clock. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.

APPENDIX C

Normalized Cumulative Frequency Distribution of Flight Indices
and Laboratory Test Scores for the Squadron VT86-RIO Population
(Pre-1978 Flight Syllabus)
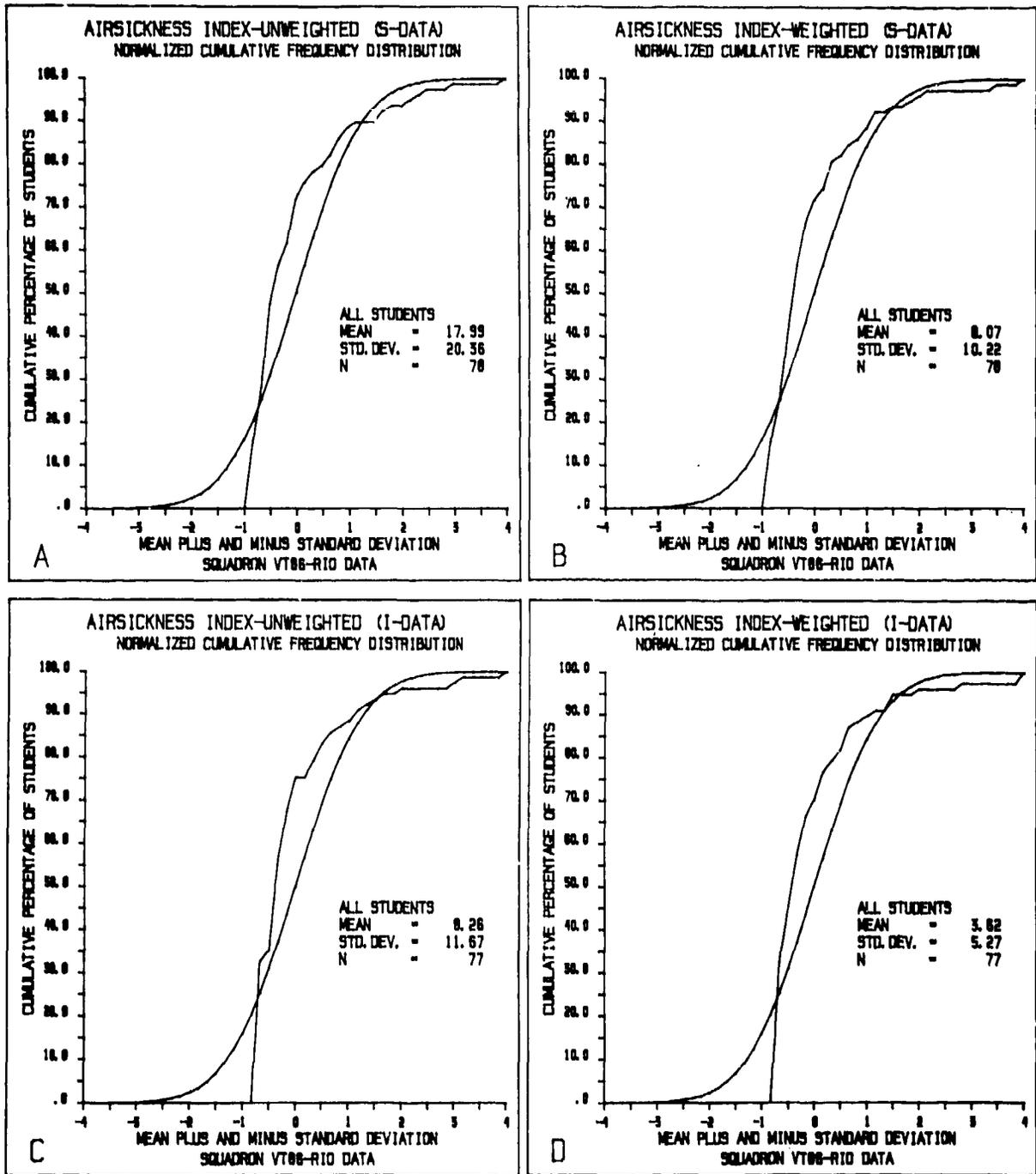
Figure C1

Normalized cumulative frequency distributions of unweighted (A) and weighted (B) airsickness indices calculated from the student questionnaire data and the equivalent unweighted (C) and weighted (D) indices calculated from the instructor data. Each plot contains the distribution of the observed data (irregular curve) and an equivalent Gaussian distribution (smooth curve) with the same mean and standard deviation as the observed data. The weighted student data (B) indicate that approximately 15 percent of the students never reported experiencing airsickness during flight training in this squadron. The same data show that a weighted airsickness index of approximately 19.8 defined the upper decile (most sensitive students) of the distribution.
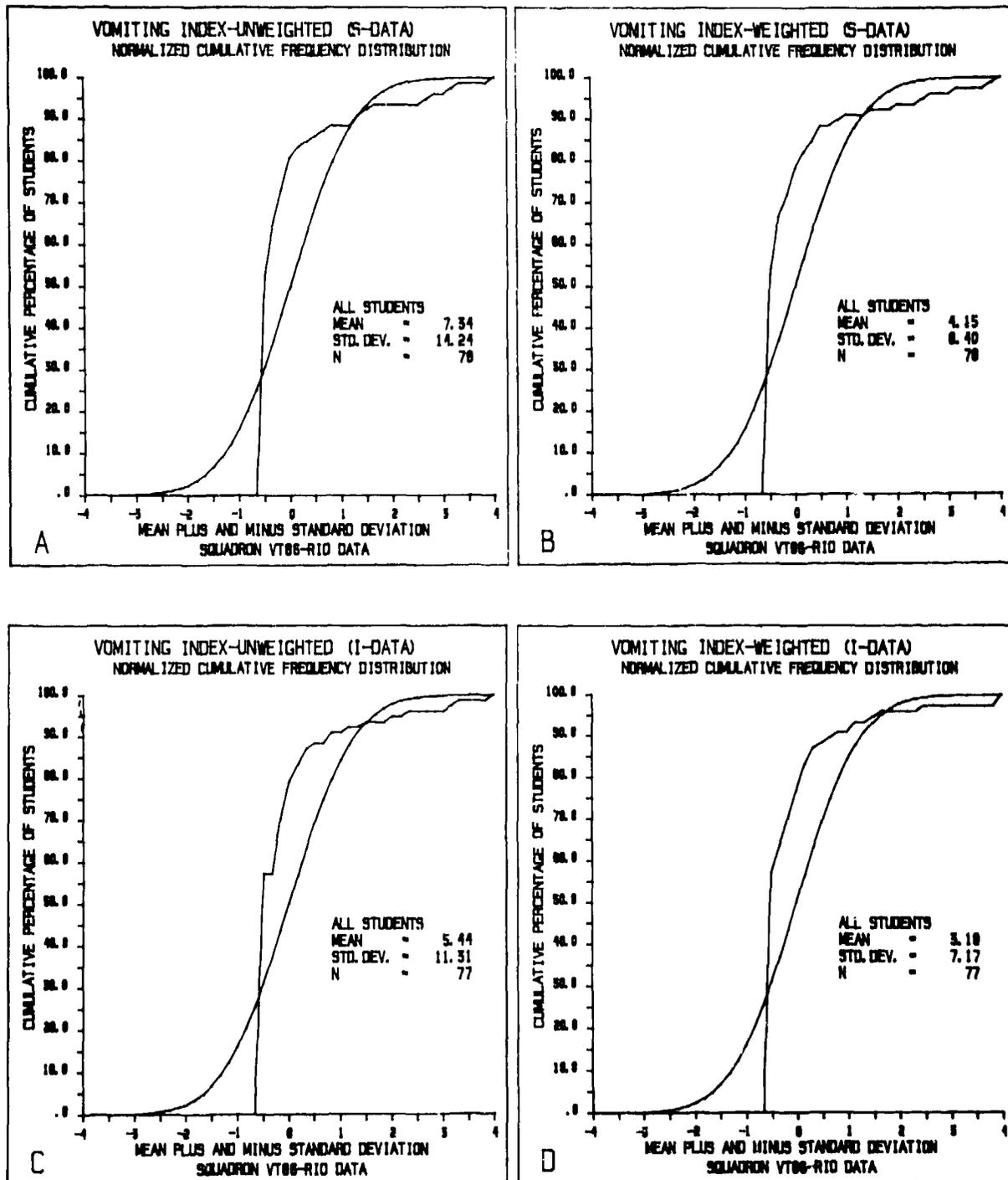
Figure C2

Normalized cumulative frequency distributions of unweighted and weighted vomit indices follow-ing the Figure C1 format. The weighted student data (B) indicate that approximately 52 percent of the students never vomited during flight training. A weighted index of approximately 12.2 defined the upper decile for this distribution.
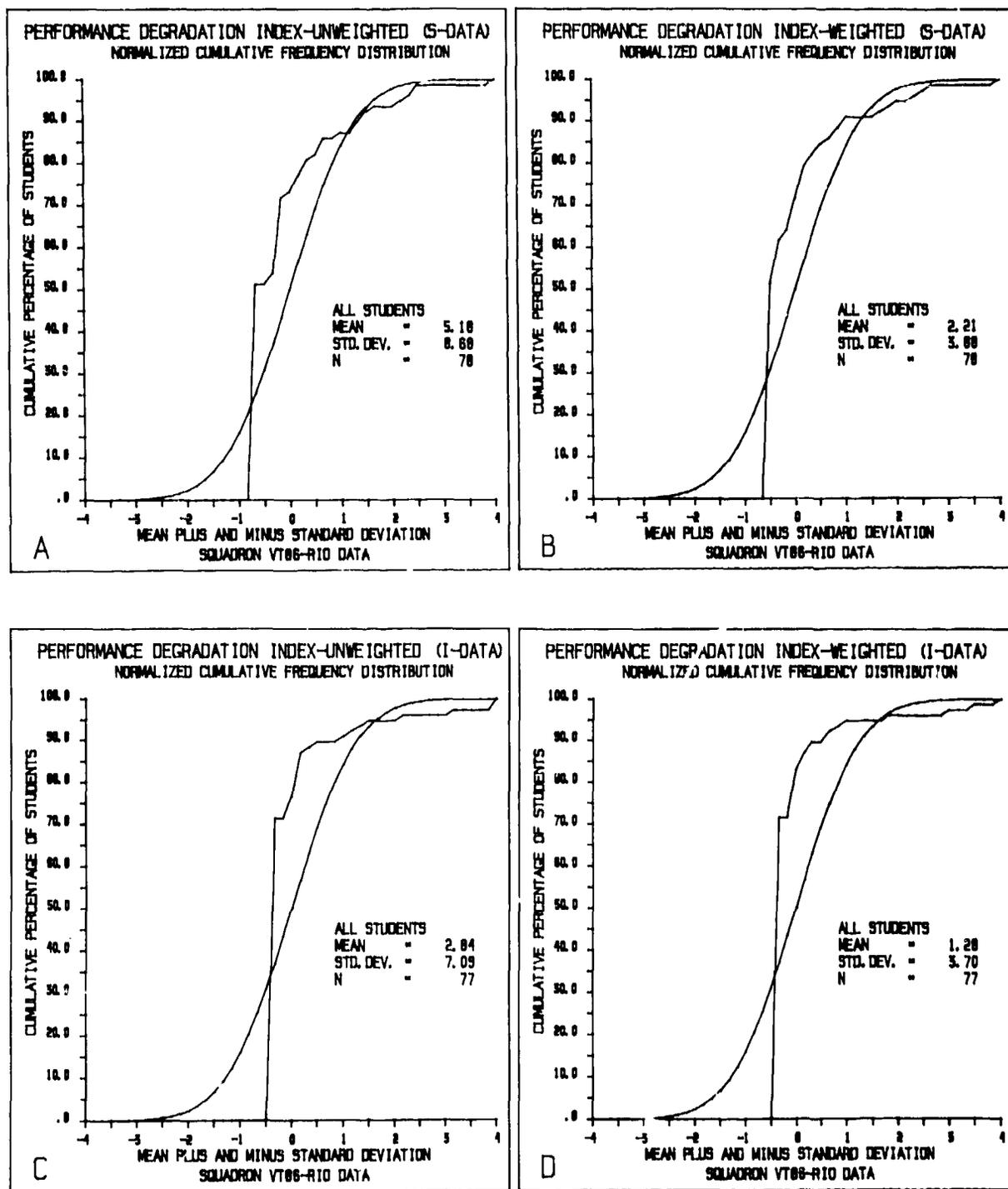
Figure C3

Normalized cumulative frequency distributions of unweighted and weighted performance degrada-
tion indices following the Figure C1 format. The weighted student data (B) indicate that
approximately 51 percent of the students reported never experiencing performance degradation
due to airsickness during flight training. A weighted index of approximately 6.2 defined the
upper decile for this distribution.
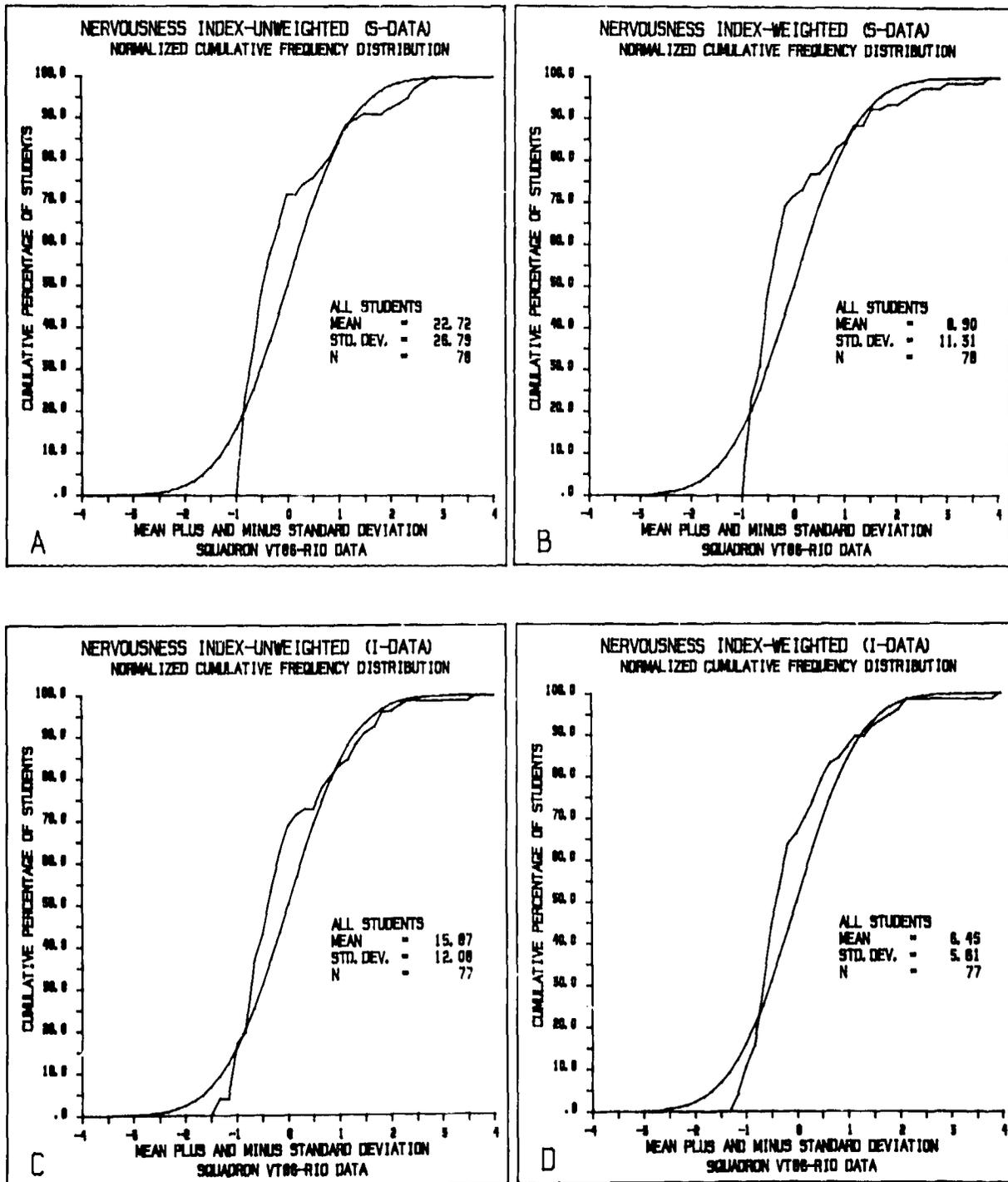
Figure C4

Normalized cumulative frequency distributions of unweighted and weighted nervousness indices following the Figure C1 format. The weighted student data (B) indicate that only 23 percent of the students reported never experiencing nervousness prior to or during a flight. A weighted index of approximately 25.7 defined the upper decile for this distribution.

MEDICATION USAGE INDEX-WEIGHTED (S-DATA)
NORMALIZED CUMULATIVE FREQUENCY DISTRIBUTION

ALL STUDENTS
MEAN = 3.00
STD. DEV. = 11.42
N = 78

MEAN PLUS AND MINUS STANDARD DEVIATION
SQUADRON VT86-RIO DATA

A

TURBULENCE INDEX-UNWEIGHTED (I-DATA)
NORMALIZED CUMULATIVE FREQUENCY DISTRIBUTION

ALL STUDENTS
MEAN = 18.40
STD. DEV. = 11.03
N = 77

MEAN PLUS AND MINUS STANDARD DEVIATION
SQUADRON VT86-RIO DATA

B

TURBULENCE INDEX-WEIGHTED (I-DATA)
NORMALIZED CUMULATIVE FREQUENCY DISTRIBUTION

ALL STUDENTS
MEAN = 8.42
STD. DEV. = 4.96
N = 77

MEAN PLUS AND MINUS STANDARD DEVIATION
SQUADRON VT86-RIO DATA

C

Figure C5

Normalized cumulative frequency distributions of the student-derived medication usage index (A) and the instructor-derived unweighted (B) and weighted (C) turbulence indices. The medication data again emphasize the relatively small number of students reporting the use of airsickness drugs during training. The turbulence data, as compared to the other indices, more closely approach a normal distribution.

C-5
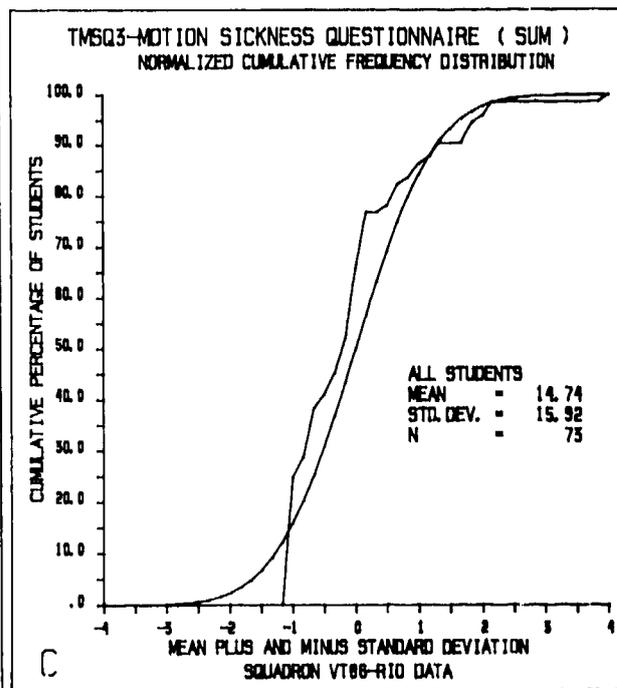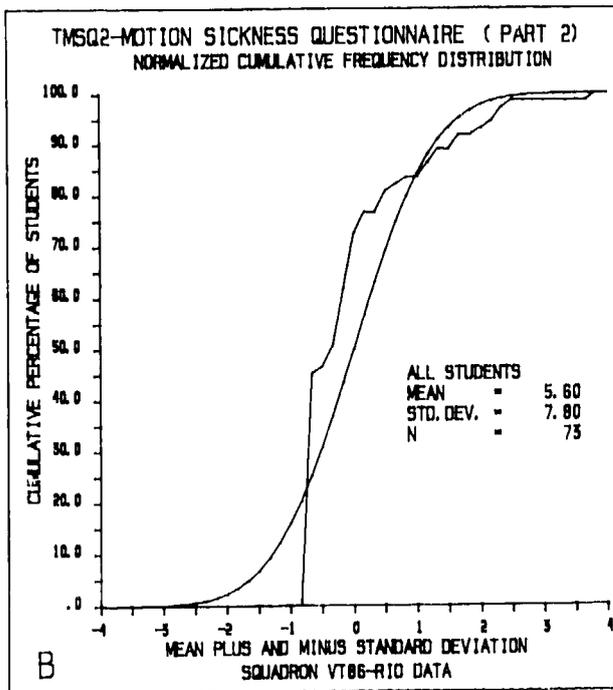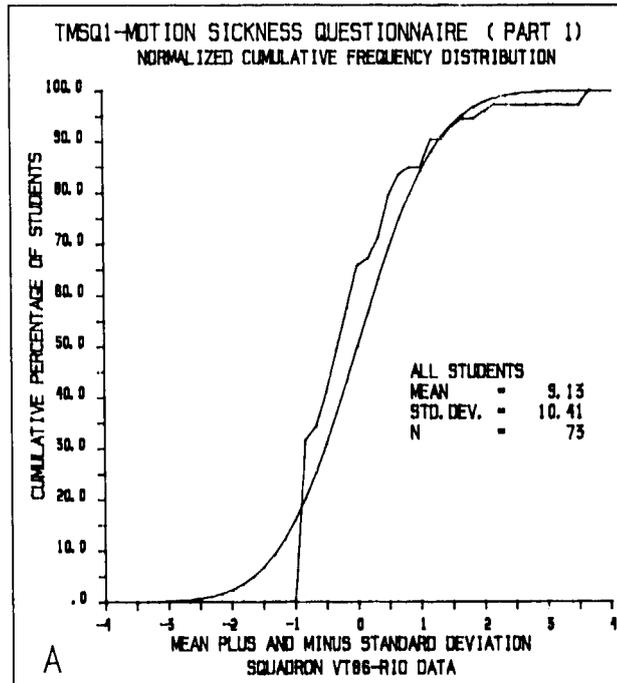
Figure C6

Normalized cumulative frequency distributions (irregular curve) of the three motion sickness
history scores derived from the study population. Each plot also shows the equivalent distri-
bution of a theoretical Gaussian population (smooth curve) with the same mean and standard
deviation as the related laboratory test scores.

TSANXQ-STATE/ANXIETY QUESTIONNAIRE
NORMALIZED CUMULATIVE FREQUENCY DISTRIBUTION

ALL STUDENTS
MEAN   =   31.95
STD. DEV.   =   11.68
N   =   22

A

TTANXQ-TRAIT/ANXIETY QUESTIONNAIRE
NORMALIZED CUMULATIVE FREQUENCY DISTRIBUTION

ALL STUDENTS
MEAN   =   27.86
STD. DEV.   =   6.18
N   =   22

B
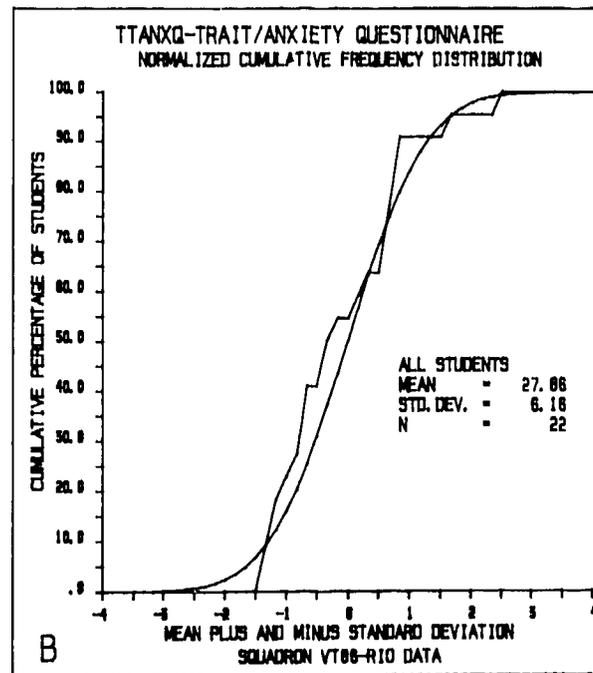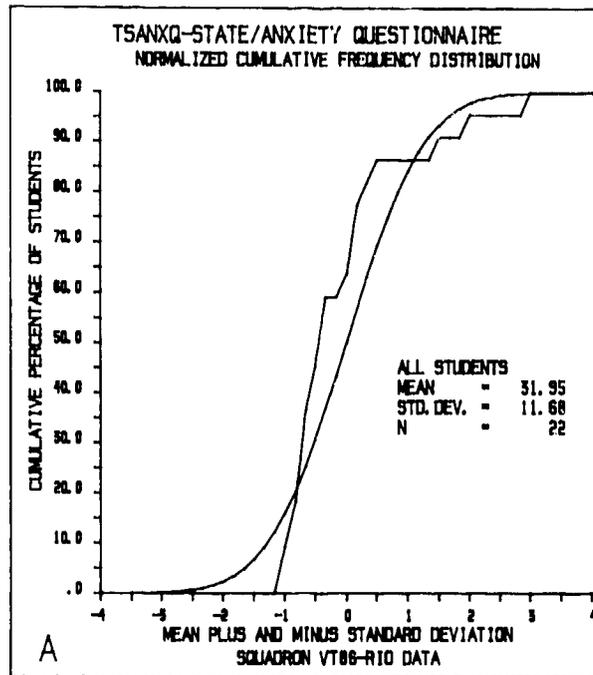
Figure C7

Normalized cumulative frequency distributions of state/anxiety (A) and trait/anxiety (B) test scores based upon the observed data (irregular curves) and a theoretical Gaussian population (smooth curves) having the same mean and standard deviation as the observed test scores.
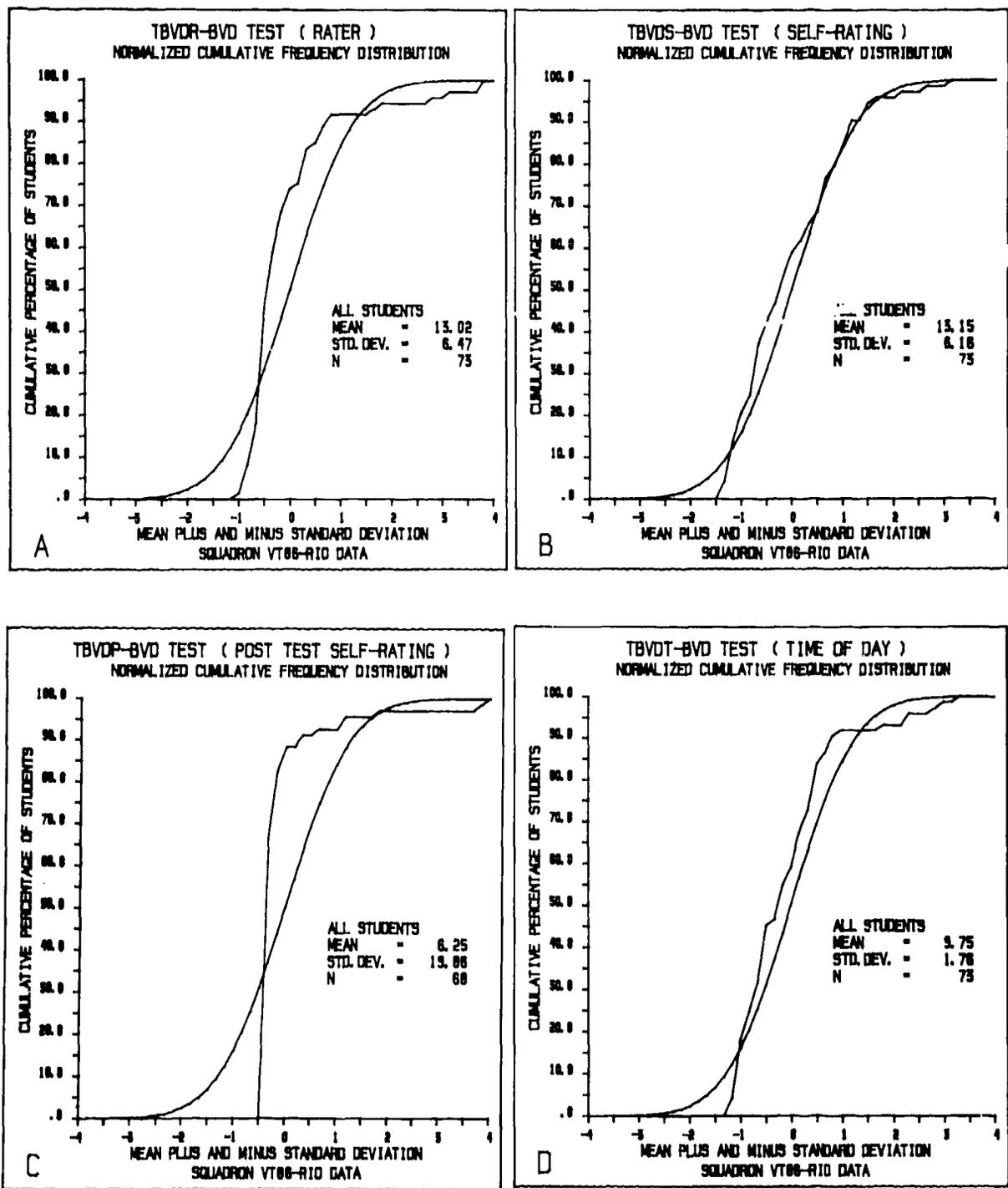
Figure C8

Normalized cumulative frequency distributions of the Brief Vestibular Disorientation Test (BVDT) scores (irregular curves) and equivalent theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations.
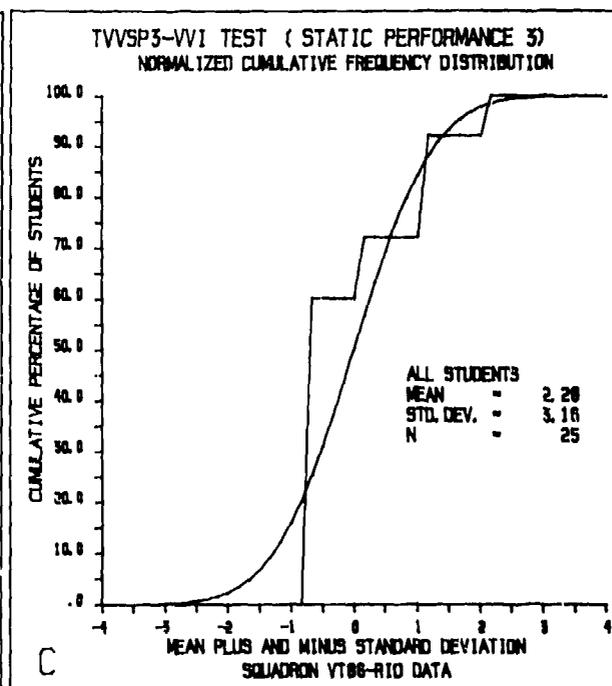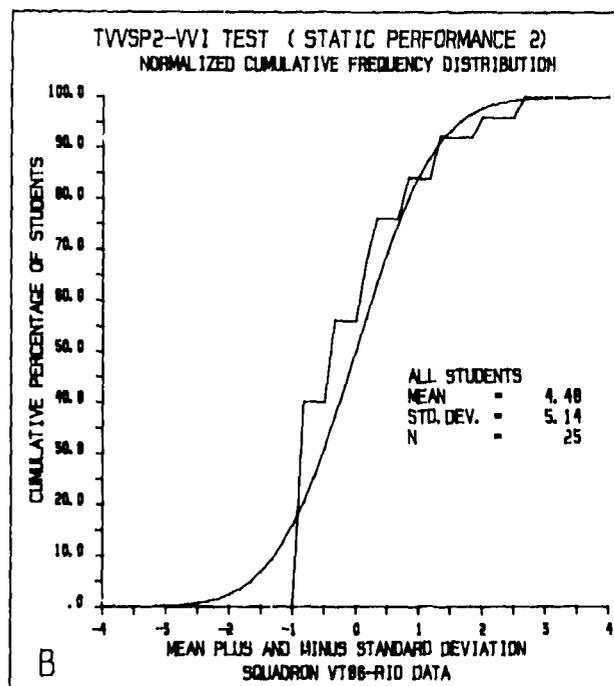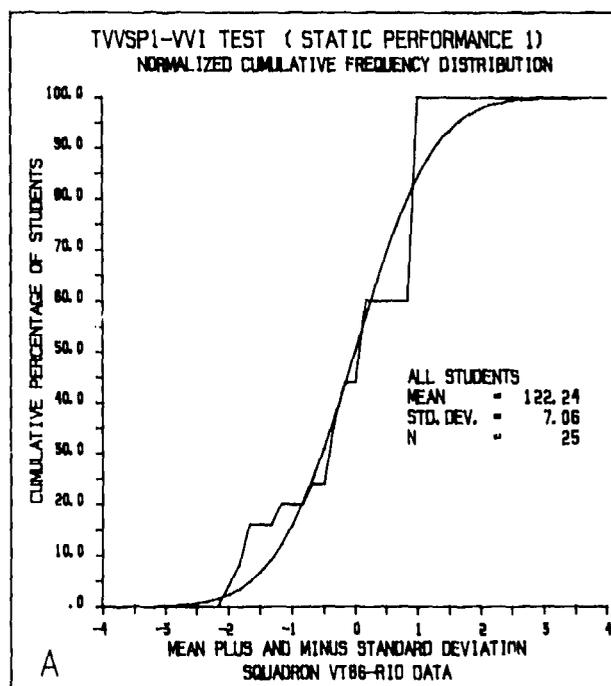
Figure C9

Normalized cumulative frequency distributions of three static performance test scores (irregular curves) associated with the Visual-Vestibular Interaction Test (VVIT) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

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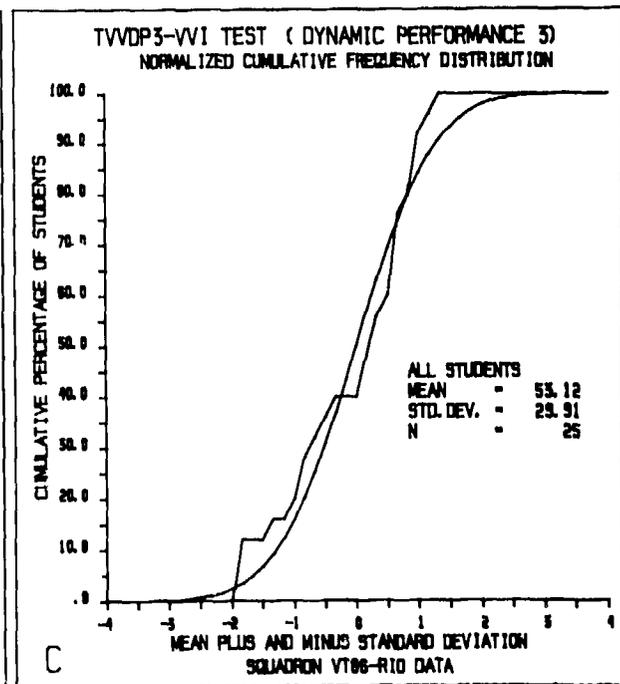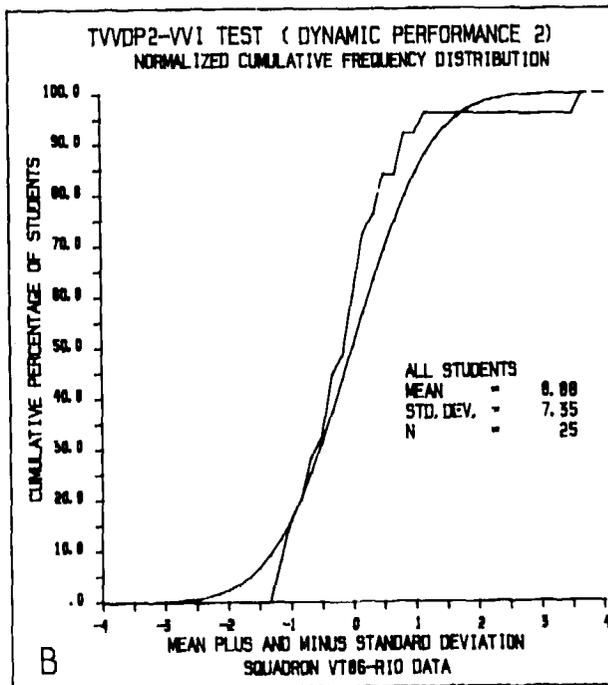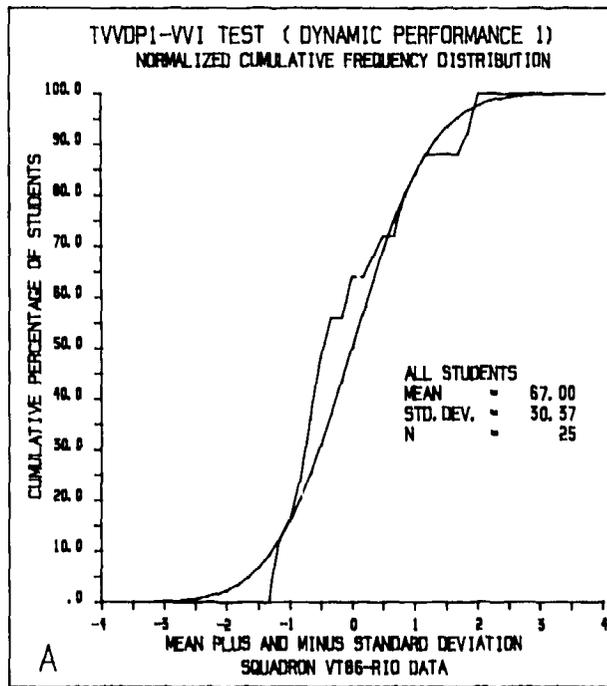
Figure C10

Normalized cumulative frequency distributions of the three dynamic performance test scores (irregular curves) associated with the Visual-Vestibular Interaction Test (VVIT) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.
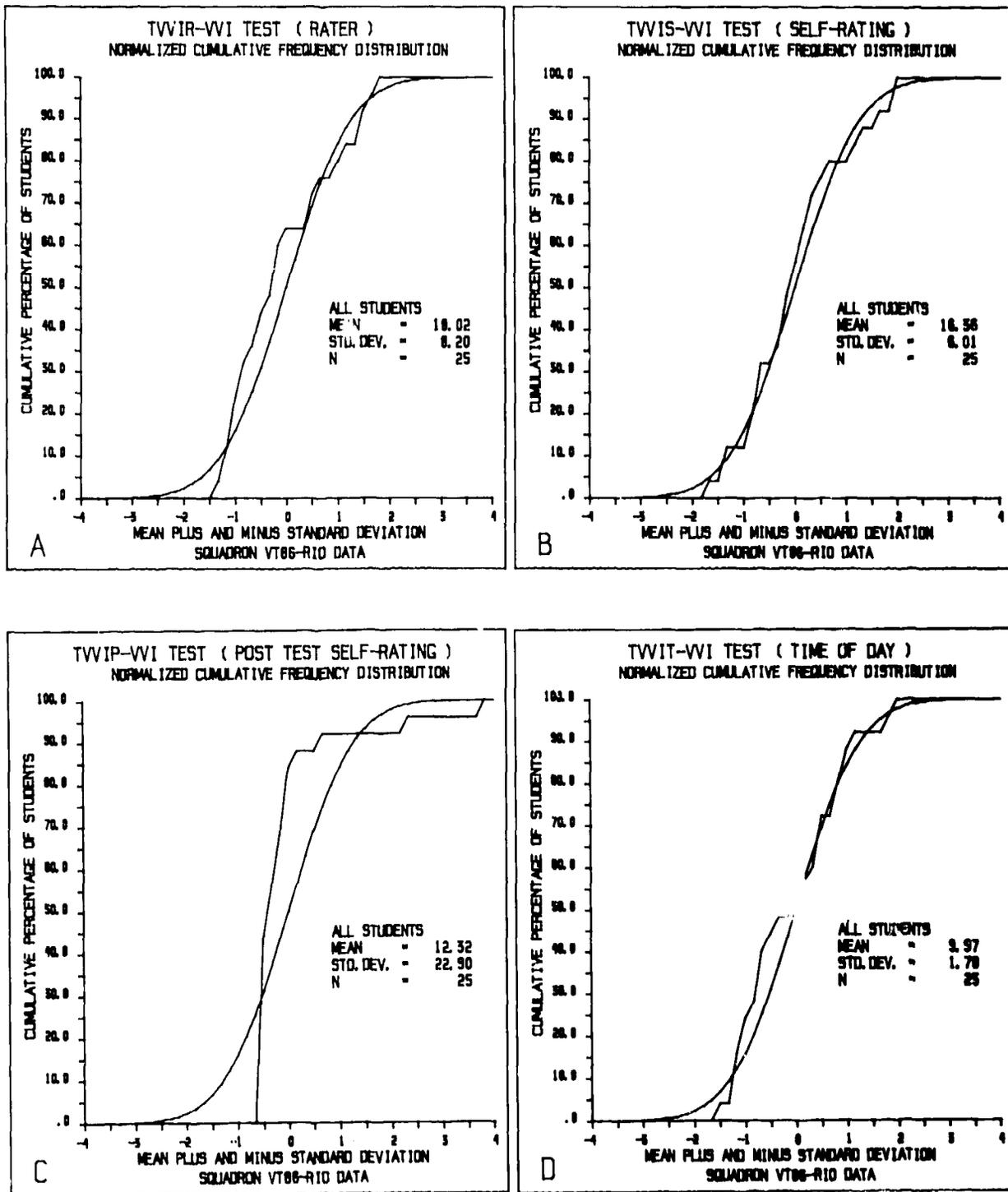
Figure C11

Normalized cumulative frequency distributions of the Visual-Vestibular Interaction Test
(VVIT) scores (irregular curves) and the related theoretical distributions (smooth
curves) of Gaussian populations with the same means and standard deviations as those of
the test scores.

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performance to have been degraded by airsickness on one or more hops. Of the total number of hops flown, airsickness, vomiting, and performance degradation were reported to have occurred on 15.7, 6.2, and 4.4 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.